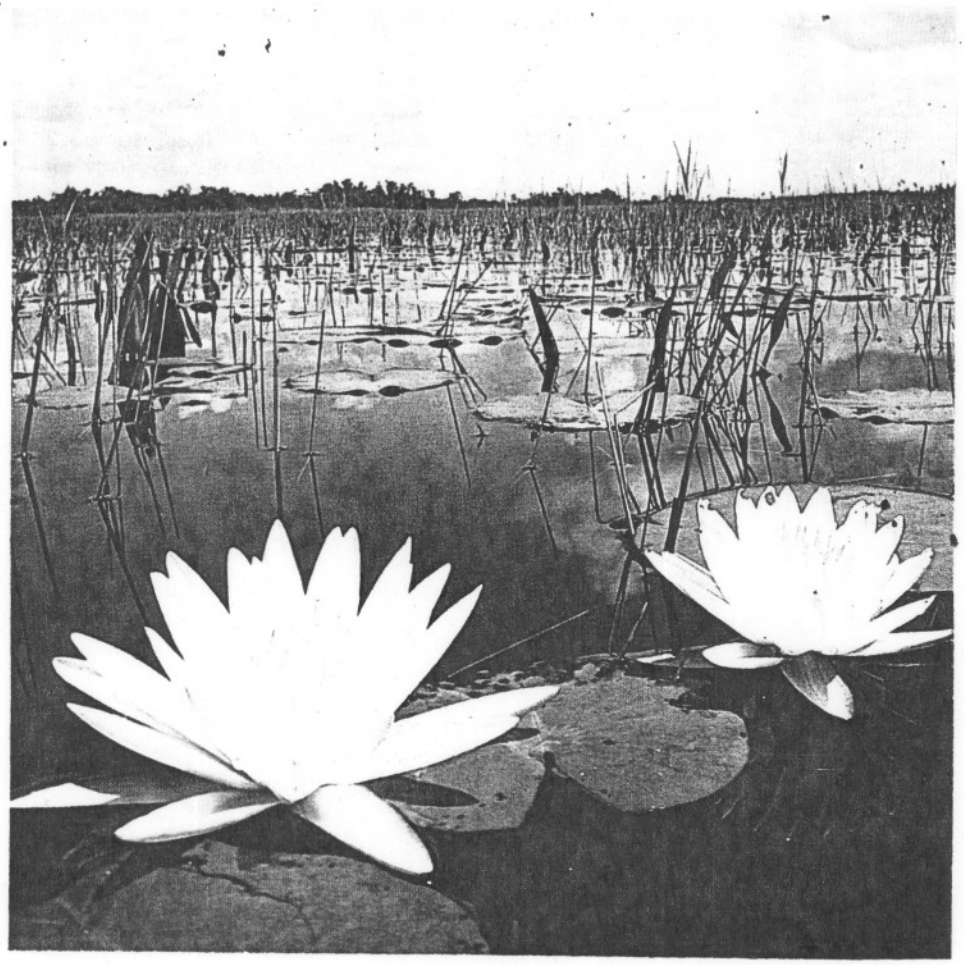
January 1990

8950006.1

89-5-104

On-Refuge

1988 MONTEZUMA NATIONAL WILDLIFE REFUGE CONTAMINANT REPORT



1988 MONTEZUMA NATIONAL WILDLIFE REFUGE

CONTAMINANT STUDY

Prepared by:

Michael F. Stoll, Sr.
Fish and Wildlife Biologist

Under the Supervision of:

Leonard P. Corin
Field Supervisor

U.S. Fish & Wildlife Service
Fish and Wildlife Enhancement
New York Field Office
Cortland, NY

January 1990

ABSTRACT

This report provides partial lists of both freshwater algae and benthic invertebrates found at the Montezuma National Wildlife Refuge and in Black Brook, a principle water source at the time this study was conducted.

It further provides information on the following water quality parameters: pH, air temperature, water temperature, water depth, dissolved oxygen, conductivity, total coliform bacteria, water transparency, carbonates, chlorides, sulfates, and suspended solids.

Lastly, it provides the results of analyses for several potentially harmful contaminants in the common carp (Cyprinus carpio), brown bullhead (Ictalurus nebulosus), largemouth bass (Micropterus salmoides), and snapping turtle (Chelydra serpentina).

While no major concerns were identified, a baseline was established against which future changes can be compared.

ACKNOWLEDGEMENTS

The support and assistance of Gene Hocutt (Refuge Manager), Tracy Gingrich, Paul Benvenuti, Anne Marocchini, Mel Norsen, Steve Flanders, and Maura Sheehan from the Montezuma National Wildlife Refuge was greatly appreciated. Field sampling was made possible through the assistance of Bill Gill (Assistant Field Supervisor), Carl Schwartz, and Steve Patch of the New York Field Office, Division of Fish and Wildlife Enhancement (NYFO). Steve Patch also spent several hours assisting in the separation and identification of the benthic invertebrates. Leonard Corin (Field Supervisor) and John Hickey of the NYFO reviewed the report and offered substantive comments. Thanks is also due Anne Secord who put up with incessant questions and Megan Patch for typing it, both of the NYFO.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

I. INTRODUCTION

Montezuma National Wildlife Refuge (Refuge), located at the north end of Cayuga Lake, is in the heart of the Finger Lakes Region of central New York State. The 6,432-acre Refuge is situated within Tyre and Seneca Falls Townships in Seneca County. The Refuge headquarters is located on U.S. Routes 5 and 20, near the Menard Memorial Bridge over the Seneca River and Barge Canal. The Refuge is 35 miles west of Syracuse, 40 miles north of Ithaca, and 45 miles east of Rochester, NY. It is bordered on the south, east, and north by segments of the New York State Barge Canal system. The western boundary is irregular, following segments of New York State Route 89, Gravel Road, East Tyre Road, and Lay Road. U.S. Routes 5 and 20, State Route 89, and the New York State Thruway pass through the interior of the Refuge (see Figure 1).

Contaminant concerns have been important to the management of the Refuge for several years. An earlier action plan for the Refuge addresses buried containers of herbicide and pesticide. This burial, located near the Refuge headquarters has been studied by the United States Fish and Wildlife Service (Service) in conjunction with an United States Environmental Protection Agency (USEPA) contracted Field Investigation Team. That thorough analysis rated the burial site as non-hazardous.

Remaining contaminant concerns at the Refuge include possible contamination from the New York State Thruway which intersects the Refuge as it runs in an east-west axis across New York State.

Of primary concern from an environmental contaminant standpoint is the Seneca Meadows Landfill, a 2,000+ acres landfill including an old portion that is a New York State designated hazardous waste site. Seneca Meadows is the largest landfill in New York State outside the metropolitan New York City area. Concern existed that leachate from this landfill may be entering the Refuge via Black Brook. Black Brook enters the Refuge at its northwest corner along the southwest border of the Tschache Pool. Water from the Tschache Pool may either flow into the Clyde River or enter the Mays Point Pool and from there pass under the New York State Thruway in a southerly direction into the Main pool.

A related study by Refuge personnel has allowed development of a water source from the Seneca/ Cayuga Canal above the New York State Barge Canal lock into the Main pool area of the Refuge, thus providing a water source for the West pool, Mays Point Pool and possibly Tschache Pool separate from Black Brook.

The Refuge consists of various wildlife habitats, including open marsh, cattail marsh, swamp woodland, and small areas of upland woods and grassland fields totalling 6,432 acres (Table 1) (Service 1986/1987/1988). The Refuge serves as a resting and feeding area for migratory ducks and geese, and as a summer nesting area for Canada geese (Branta canadensis) and several species of ducks. It also provides seasonal or year-round habitat for many other waterbirds, song birds, fish, amphibians, reptiles, whitetailed deer (Odocoileus virginianus), and other mammals.

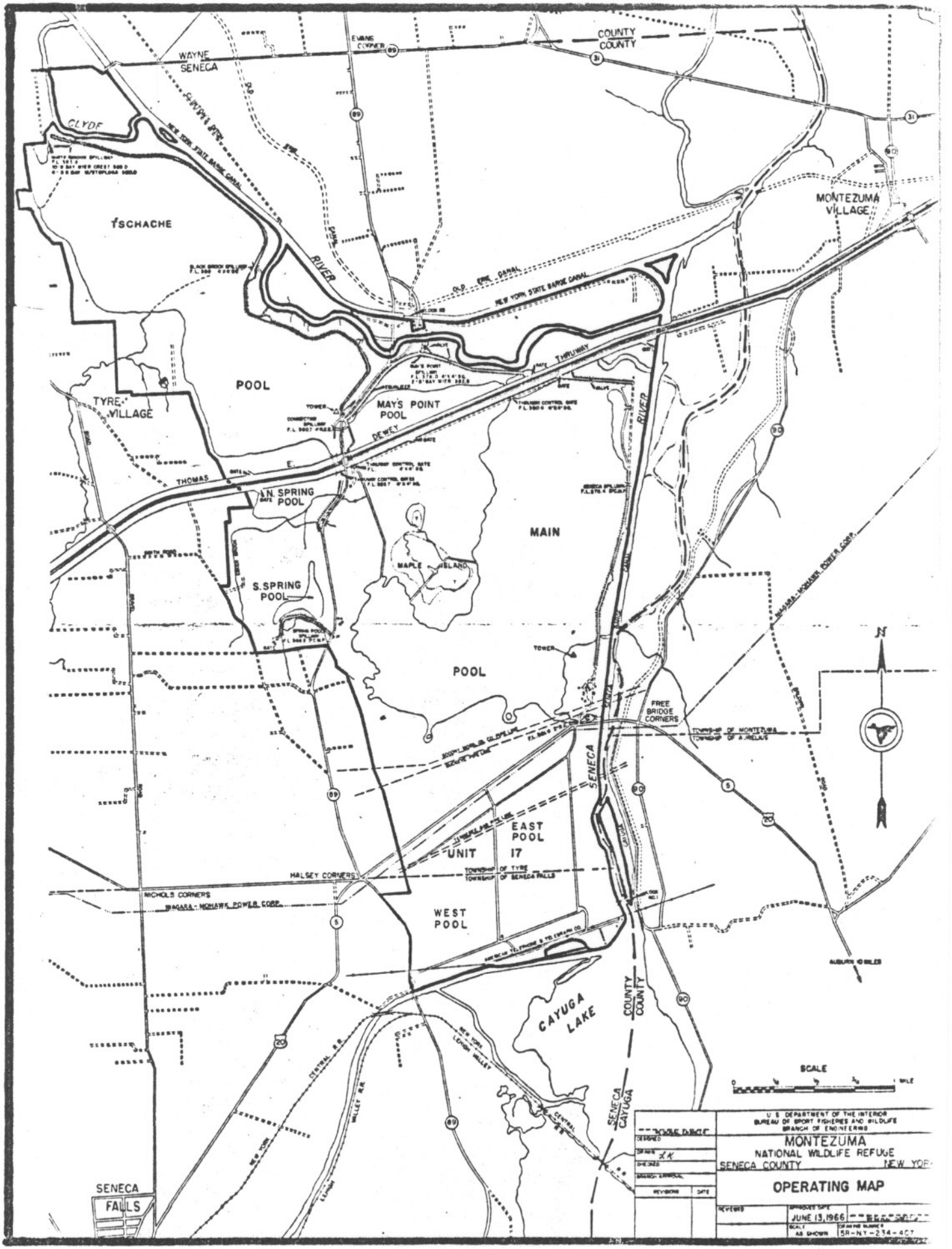


FIGURE 1. Map of Refuge & Surrounding Area

TABLE 1

LAND TYPE INVENTORY

LAND CLASSIFICATION	ACRES	% OF TOTAL
Wetland Types:		
Riverine	42	.7
Palustrine	3,600	56.0
Upland Types:		
Grassland	560	8.7
Woodland	2,000	31.1
Brush	170	2.6
Administrative Lands (Bldgs., Parking, Roads, etc.)	60	.9
TOTAL REFUGE ACRES	6,432	100.0

The marshes in the three principal pools (Main Pool, May's Point Pool, and Tschache Pool) are characterized by stands of cattail (Typha sps.). Purple loosestrife (Lythrum salicaria), an introduced species that reached the Refuge in the 1950's and covered over 1,500 acres of marsh by the mid-1970's, has receded steadily due to judicious manipulation of water levels. However, it is still present in sizeable stands in some locales. Other major plant species found in the aquatic beds include white water lily (Nymphaea sp.) and pondweed (Potamogeton sps.).

Tree species dominant in the refuge's forested wetlands include red maple (Acer rubrum), red ash (Fraxinus pennsylvanica), swamp white oak (Quercus bicolor), and blue beech (Carpinus caroliniana). Tschache Pool was a forested wetland prior to being flooded. Over 90% of the trees have fallen, and those that remain standing are dead and widely dispersed.

Upland forest sites, including Clark's Ridge and Esker Brook, are dominated by hickory (Carya sp.), black walnut (Juglans nigra), and white ash (Fraxinus americanus).

There are two Research Natural Areas (RNA) on the Refuge. Maple Knoll, an 8-acre tract located southwest of Tschache Pool, is the only beech-maple stand on the Refuge. The second RNA, Swamp Woods, is a tract of about 100 acres of black ash (Fraxinus nigra), red maple, and some American elm (Ulmus americana) located southwest of the Main Pool.

On the Refuge's grassland areas, vegetative types are principally remnants of pasture and hayland plantings over the last 40 years. These include timothy (Phleum pretense), orchardgrass (Dactylis glomerata), birdsfoot trefoil (Lotus corniculatus), fescue (Festuca sp.), and reed canary grass

(Phalaris arundinacea). A wide variety of forbs and herbs are also present in the grassland fields. Many of these fields were farmed in the past and some areas are periodically mowed to hold back succession.

The varied habitats of the Refuge provide food and cover for numerous species of birds, mammals, reptiles, amphibians, and fish.

Significant resting and feeding use by bald eagles (Haliaeetus leucocephalus) occurs, with three to seven individual birds using the Refuge at different times during spring, summer, and fall. This use is partly attributable to the eagle hacking program on the Refuge between 1976 and 1980 and even larger nearby hacking programs since 1981. In 1987, for the first time in over 30 years, two young bald eagles were successfully fledged from a nest on the Refuge. The osprey (Padion haliaetus), a New York State designated endangered species, nests on the Refuge. This use is the first recorded nesting by ospreys in the central New York area in over 100 years.

A management program for the eastern bluebird (Sialia sialis) (a New York State designated species of special concern) began on the Refuge in 1981. Since then, 53 bluebirds have been produced in nest boxes on the Refuge.

The Refuge has assumed a significant role in the Atlantic Flyway as a resting and feeding area for migratory waterfowl. The peak number of mallards (Anas platyrhynchos) spending mid and late fall on the Refuge has twice exceeded 200,000 birds. Over 15,000 American black ducks (Anas rubripes) have been recorded in the fall. A significant proportion of the mid-Atlantic population of Canada geese now utilizes the Refuge and central New York during spring and fall migrations. Spring peaks of 135,000 Canada geese are not uncommon and an average of 15,000 snow geese (Chen hyperborea) spend each spring on the Refuge.

Blue-winged teal (Anas discors), mallard, wood duck (Aix sponsa), and Canada geese are the most abundant nesting waterfowl. Table 2 summarizes waterfowl production estimates for the past five years.

Beginning in 1982, for the first time in the Refuge's 49-year history, great blue herons (Ardea herodias) established a colony. There were over 100 active nests present during 1987, a dramatic increase from the two nests built in 1982. There is some concern for the nesting habitat available for great blue herons. While the number of great blue herons nesting in Tschache Pool increases, the available nesting habitat (snags) decreases. The snags are the remains of the hardwood forest that was flooded in the 1940's. Over time, the snags have rotted and fallen.

May's Point Pool is drawn down to create mudflats for migrating shorebirds each September. This provides the best shorebird viewing in the Finger Lakes region with over 25 species frequently sighted. Visitors flock to the dikes for some spectacular viewing of more unusual species, including Hudsonian godwit (Limosa haemastica), long-billed curlew (Numenius americanus), northern phalarope (Lobipes lobatus), and stilt sandpiper (Microphalama himantopus).

TABLE 2

FIVE-YEAR WATERFOWL PRODUCTION ESTIMATES: 1982-1986

Species	YEAR 1982	1983	1984	1985	1986
Canada Goose (Branta canadensis)	246	172	221	260	250
Mallard (Anas platyrhynchos)	162	140	94	190	70
American Black Duck (Anas rubripes)	14	12	--	10	2
Gadwall (Anas acuta)	13	45	39	40	2
Northern Pintail (Anas strepera)	13	--	--	7	--
Green-winged Teal (Anas carolinensis)	--	45	12	20	--
Blue-winged Teal (Anas discors)	17	114	24	45	--
Northern Shoveler (Spatula clypeata)	8	--	--	--	--
Wood Duck (Aix sponsa)	269	112	465	935	669
Redhead (Aythya americana)	--	12	--	--	--
Canvasback (Aythya valisineria)	9	--	--	--	--
Hooded Merganser (Lophodytes cucullatus)	7	--	--	55	2
Totals	758	682	855	1,562	995

Raptor populations have shown no noticeable changes in the last several years. Red-tailed hawks (Buteo jamaicensis), kestrels (Falco sparverius), northern harriers (i.e. Circus cyaneus), Cooper's hawks (Accipter cooperii), and great horned owls (Bubo virginianus) are all frequently sighted. Less common sightings include merlins (Falco columbarius), peregrine falcons (Falco peregrinus), and snowy owls (Nyctea scandiaca).

The size of the Refuge's white-tailed deer herd has increased over the past four years. The estimated population is between 200 and 300 animals.

Other mammals common to the Refuge are the raccoon (Procyon lotor), skunk (Mephitis mephitis), opossum (Didelphis verginiana), eastern cottontail (Sylvilagus floridanus), fox (Vulpes fulva), mink (Mustela vison), and weasel (Mustela sp.).

II. GOALS AND OBJECTIVES

The environmental contaminants study of the Refuge has as its goal to maintain or improve, where necessary, the environmental quality of the fish and wildlife resources of the Refuge and specifically that they be free from detrimental levels of toxic and hazardous environmental contaminants.

II. A. Specific Objectives:

1. Determine the algae indigenous to the Refuge, Black Brook, and White Brook.

2. Determine the benthic invertebrates indigenous to the Refuge, Black Brook, and White Brook; and provide a reference collection.

3. Determine the presence and levels of potentially harmful contaminants in icthiofauna and snapping turtles indigenous to the Refuge.

4. Determine the presence and levels of potentially harmful contaminants in the sediments of the Refuge, Black Brook, and White Brook.

5. Provide water quality information using selected parameters for Refuge waters, Black Brook, and White Brook. Parameters measured included pH, air temperature, water temperature, water depth, dissolved oxygen, conductivity, total coliform bacteria, and water transparency. Information on carbonates, chlorides, sulfates, and suspended solids were available from studies done in 1987.

III. METHODS

1. Algae were collected with a Wildco Student Plankton Net and preserved using 10% buffered formalin solution. Algae were identified using a standard compound microscope based on scanning several subsamples of the sample. A pictorial key was prepared and provided to the Refuge.

2. Benthic invertebrates were sampled using a Wildco Serber Sampler and preserved in 10% buffered formalin solution. Samples were later handpicked to separate the invertebrates from sediment or vegetation and identified using a standard dissecting microscope. A compound scope was used as required to ascertain proper identification. One or more specimens of each individual were saved in 10% formalin, appropriately labeled, and provided to the Refuge as a reference collection.

3. Biological specimens, selected fish and turtles, were collected using an electric backpack shocker developed by Coeffelt Electronics, or by hand in the case of the turtles. Specimens were frozen and either submitted whole (fish) or by tissue group [fat, egg, liver and muscle] (turtle) for analysis using the most current protocols approved by the Service. The analyses were performed under the direction of the Service's Patuxent Analytical Control Facility. Fish, without thawing, were wrapped in tinfoil (shinny side out, rinsed with hexane and air dried) and packed in dry ice for shipment. Turtles were dissected and individual tissues wrapped as for fish were placed in polyethylene bags. All samples were appropriately labeled.

4. Sediment samples were collected using a stainless steel Eckman Dredge fabricated by Wildco Supply, or a Petite Ponar Dredge. Prior to the taking of each grab, the dredge was scrubbed with a brush and strong detergent, rinsed with distilled water, rinsed with acetone, rinsed with distilled water, rinsed with 10% Nitric acid and lastly, with a double rinse of distilled water. The portion of dredge grab used for the actual analysis was removed from the center, at least 1 cm from any side, using a stainless steel spoon and placed in a prewashed sample jar, labelled, frozen, and submitted for analysis using the most current Service approved protocols. Analyses were performed under the direction of the Service's Patuxent Analytical Control Facility.

5. Descriptions of the methods used to analyze the sediment, fish, and turtle samples can be found in the appropriate appendices.

6. Water quality information was collected on the following parameters:

   A. Coliform Bacteria: Analyses were made by Buck Engineering and Environmental Laboratory of Cortland, New York. Buck Engineering provided the sterilized sample bottles and 24 hour turnaround. They are both New York State Department of Health and New York State Department of Environmental Conservation certified. Water samples were taken by immersing the open mouth of the bottle below

the surface of the water, allowing the water to just fill the sample bottle. Samples were then placed on ice and transported to Buck Engineering the same day as collected.

B. Conductivity: It was measured using a calibrated meter (Fisher Scientific Model 152 Conductivity Meter) in the field.

C. Temperature: It was measured using either a calibrated meter or thermometer in the field. In most cases the Fisher Scientific Model 152 Conductivity Meter was used to provide this measurement.

D. pH: It was measured in the field using a calibrated meter. (Accumet Model 955 Portable Meter).

E. Dissolved Oxygen: It was measured in the field using the Accumet Model 955 Portable Meter in conjunction with the Orion Research Oxygen Probe.

7. Quality Assurance/Quality Control

All water and sediment samples were collected and preserved using standard methods. Accepted techniques developed by the Service were used for the collection of fish and other tissues. Pre-cleaned bottles and jars were used whenever possible. Costs of analytical work were funded by the Service. The analytical work was carried out by the Patuxent Analytical Control Facility or by one of their contract laboratories following strict quality control procedures. Samples were prepared and shipped by the New York Field Office.

8. Human Safety Concerns

This section relates to the safety of personnel carrying out this study.

Humans may be exposed to toxic substances via inhalation, skin contact, and ingestion of contaminated food and water. Until the nature of the contamination on the Refuge was determined, care was taken to avoid skin exposure while in the field carrying out sampling, especially of sediments. Protection procedures included the use of gloves and boots and washing equipment, clothing and exposed skin areas after each sampling. Until the determination of the contaminants present on the Refuge was made, workers made every effort to avoid direct skin exposure to sediments and immediately reported any chemical odors observed in the field while sampling or processing samples. Had any situation arisen where there was suspicion or observation of possible chemical contamination of samples, field sampling would have ceased and a report been made to the Refuge Manager and contaminant specialist.

IV. STATIONS

Twenty stations were selected on or immediately adjacent to the Refuge in 1986. These included one station each in White and Black Brooks and two stations in the Seneca/Cayuga Canal [Seneca River]. The location of the several stations are shown in Figures 2 (Refuge) and 3 (Black Brook). The snapping turtle capture locations are shown in Figure 4. Descriptions of the stations follow.

Station 1: This site is located approximately 15 meters east of the Gravel Road bridge. Characteristics of the brook consist of very slow moving water, rock and mud bottom, and no vegetation.

Station 2: This site is located just under east side of the Gravel Road bridge. Characteristics of the brook consist of fairly shallow rapidly moving water, rocky bottom with algae growth on rocks, and no vegetation.

Station 3: This site is located approximately 1/2 kilometer downstream of Station 2. Characteristics of the site include a very slow moving stream, with clay, rocks, sticks, and logs making up the bottom, and no vegetation. The only vegetation observed was old field vegetation located on the shoreline.

Station 4: This site is located about 1/3 the way between the shore (pumphouse) and the marsh. Site characteristics include water with stumps, fallen trees and some algae growth, very hard mud bottom, and no vegetation.

Station 5: This site is located about 100 meters from western shore. Characteristics of site include numerous stumps, above and below water, firm bottom was firm with layer of silt, and no vegetation.

Station 6: This site is located approximately 2/3 the way between the shore and the marsh. Site characteristics include open water, a few stumps with algae growth present both above and below water surface, firm bottom with silt, and no vegetation.

Station 7: This site is located approximately 150 meters from the shore. Characteristics of site include open water with some floating algae, firm bottom, and no vegetation.

Station 8: This site is located approximately 50 meters from the shore. Site characteristics include open water with some floating algae, a few logs sticking out of the water, mucky bottom, and no vegetation.

Station 9: This site is located approximately 15-20 meters off the spillway. There was very little if any water coming through the spillway. The bottom was very soft, consisting of a combination of mud and silt. Vegetation included cattails, pondweeds, and purple loosestrife.

Station 10: This site is located in the middle of the Main Pool. The bottom was firm, consisting of a combination of mud and silt. Floating algae was observed at this open water site.

Station 11: This site is located on the southwest side of the Main Pool off a thick growth of water lilies. The bottom was mucky.

Station 12: This site is located in mid-channel. The bottom was mucky but is fairly firm further down. The water becomes murky very easily. Bubbles also appear when water is disturbed. No vegetation was observed.

Station 13: This site is in an open water area of the Main Pool. The bottom was fairly firm and no vegetation was observed.

Station 14: This site is located approximately 15 meters in front of the May's Point Pool spillway. The bottom was mucky and no vegetation was observed.

Station 15: This site is located in the southernmost end of the Main Pool approximately three meters from a big willow tree. Site characteristics include a very muddy bottom, and fairly dense vegetation with floating water lilies, phragmites (Phragmites phragmites), and coontail (Ceratophyllum demersum).

Station 16: This sampling site is located at a small walk-bridge. Site characteristics include very slowly flowing water, bottom consisting of what seemed to be bottomless silt, and shoreline vegetation consisting of duckweed (Lemna sps.) and dense patches of coontail. No vegetation was observed in the center of the canal.

Station 17: This site is located in a bay approximately 20 meters from the edge of the Cayuga/Seneca Canal. The bottom is composed of mud and silt. The water was very murky.

Station 18: This site is located on the edge of Cayuga Lake between the Cayuga/Seneca Canal Lock #1 and the Control Dam off the tip of a rocky island. The shore is made up of rocks. Algae is the only vegetation. Wave action picks up when the lock is operating.

Station 19: This site is located on the northern side of the Northern Spring Pool approximately 150 m off New York State Route 89 approximately 5 meters offshore. The bottom consists of very deep silt, trees and stumps.

Station 20: This site is located at the south end of the South Spring Pool approximately 15 meters in front of the observation deck. Site characteristics include open water with a few fallen trees and stumps, bottom composed of a thick layer of silt, and no vegetation.

In 1988 six additional sites were added in Black Brook. Descriptions of these sites follow:

Station #1BB - This site is located about 27 to 36 meters west of Burgess Road above the Seneca Meadows Landfill. Minimal flow was observed in June. The bottom consisted of clay with lenses of organic material. The organic material tended to be very soft and sticky. Algal mats were observed. The banks are well vegetated with non-woody plants.

Station #2BB - This site is located about 27 to 36 meters west of Mound Road below the Seneca Meadows Landfill. This site is similar to Station #1BB.

Station #3BB - This site is located about 27 to 36 meters west of Black Brook Road. Minimal flow and algal mats were observed. This site is similar to Stations #1BB and #2BB.

Station #4BB - This site is located just downstream of a seasonal campground on the south side of New York State Route 318 (Old State Road). A riffle/pool configuration with flow over a bottom of gravel, shale and hard packed clay was observed.

Station #5BB - This site is located about 18 to 36 meters south of Nearpass Road. The site is mostly riffle with a pool at the underpass of Nearpass Road. The bottom is firm with rocks, gravel, shale and some fines. Algal mats are in evidence.

Station #6BB - This site is located about 18 meters south of Traver Road. The bottom is very rocky to bedrock ledges with some fines. Algal clumps and mats were observed.

V. RESULTS AND DISCUSSION

The results of the 1988 work have been divided into algae, invertebrates, biological (fish and turtles), sediments and water quality. Algae were collected at all stations and identified to genus and, if possible, species. Invertebrates were handled like the algae. Fish were collected and selectively submitted for analysis for contaminants from the stations on the refuge. Snapping turtles (Chelydra serpentina) were collected as they came up to nest in the dikes of the Refuge and selected subsamples submitted for analysis for contaminants. Sediments were collected from the Refuge and submitted for analysis for contaminants. Water quality parameters (air temperature, water temperature, water depth, water transparency, dissolved oxygen, conductivity, pH, and total coliform bacteria) were recorded for all stations.

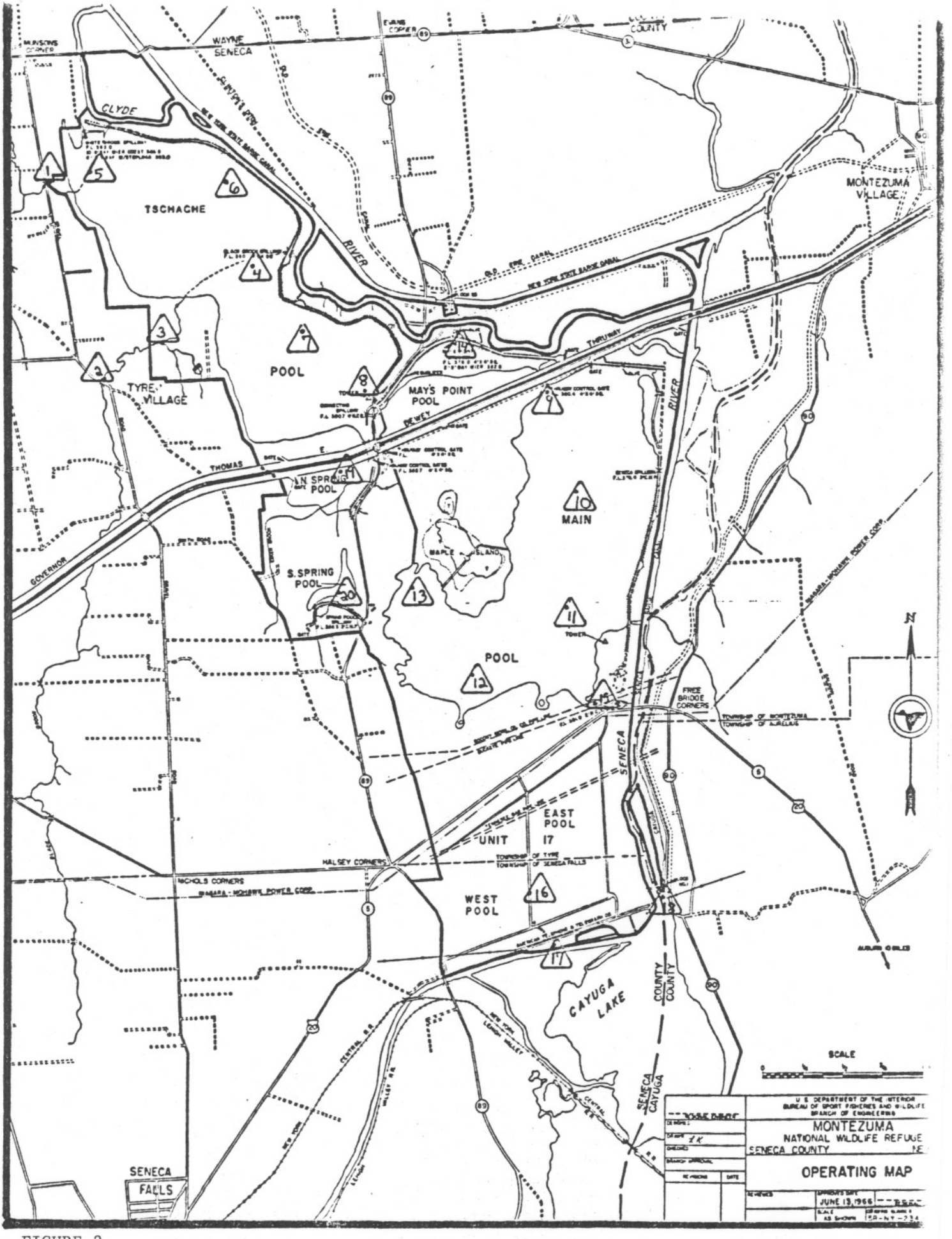


FIGURE 2.
MONTEZUMA NATIONAL WILDLIFE REFUGE SAMPLING STATIONS

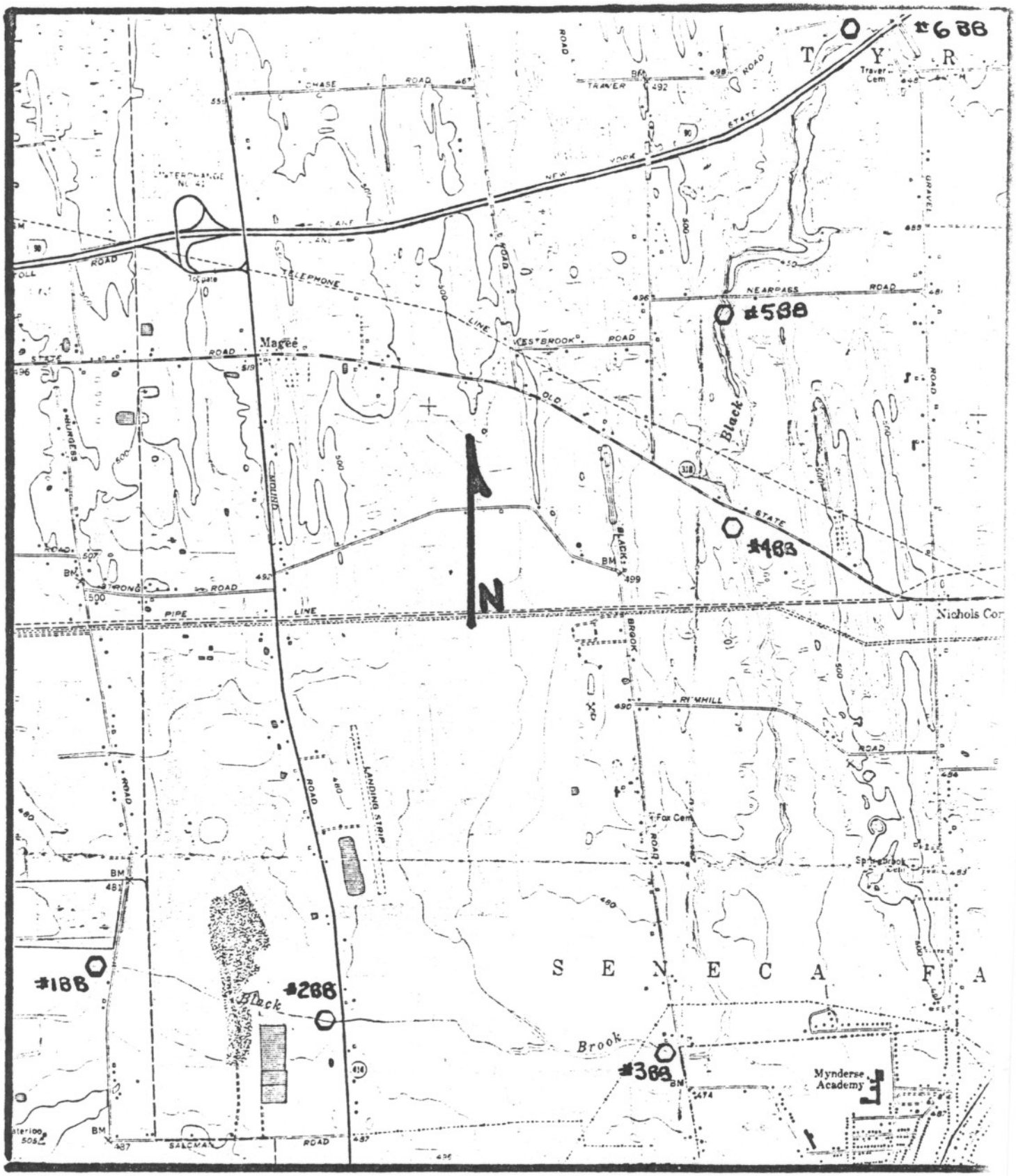


FIGURE 3.
BLACK BROOK SAMPLING STATIONS

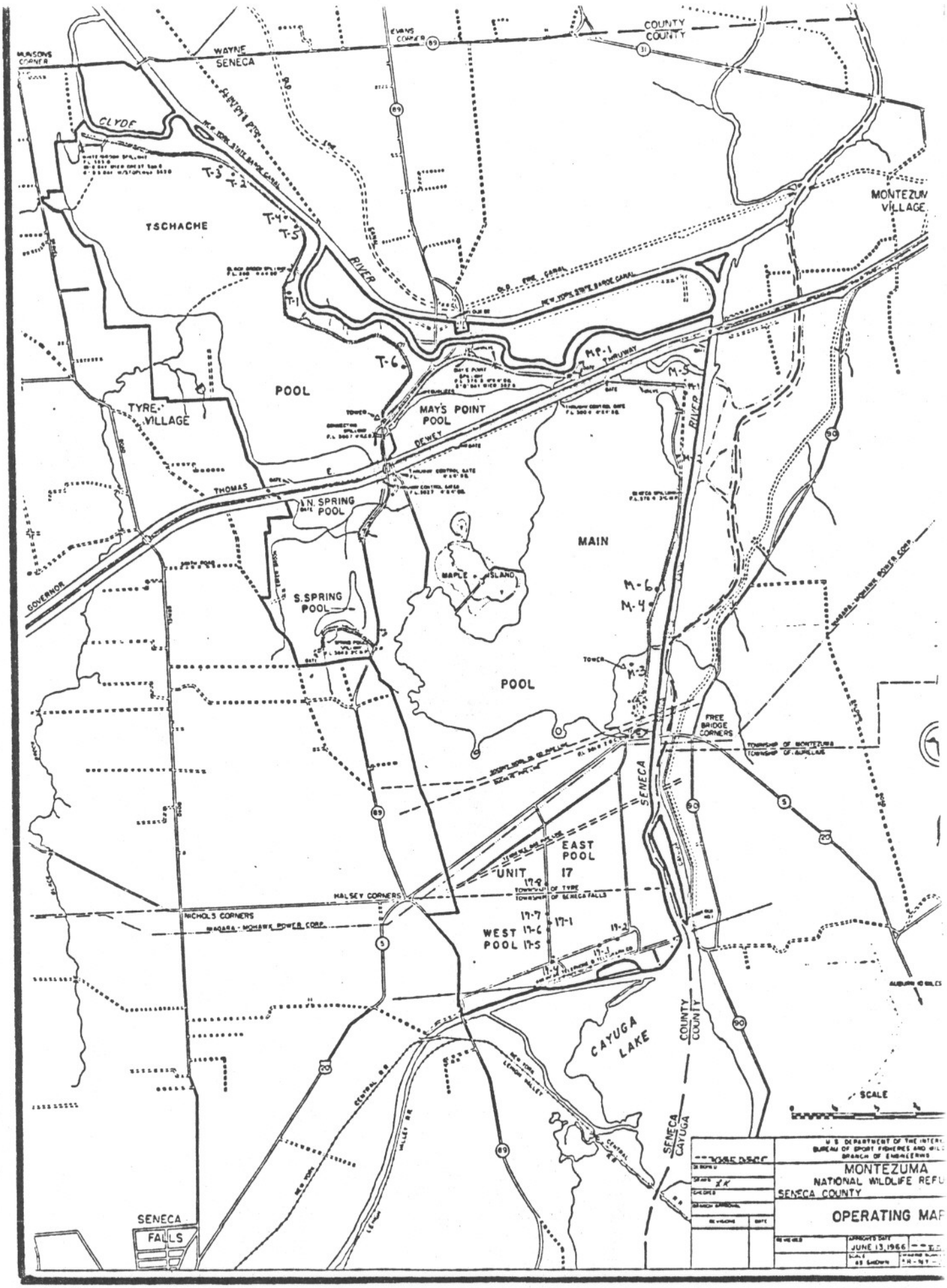


FIGURE 4.
1987 SNAPPING TURTLE CAPTURE LOCATIONS

A. Algae

Algae were identified from collections made during 1987 and augmented by supplemental collections during 1988 to describe the populations found at the several stations. The results of this effort are summarized in Table 3. Additionally, the data sheets, a pictorial key for identified species, and a phylogentic listing are found in Appendix A.

Of the 84 species of algae collected the greatest number, 55 came from the Main Pool, followed closely by the Cayuga/Seneca Canal at 51, and Black Brook at 44. No single species was collected from all nine waterbodies. Four species - Gleocystis sp, Pediastrum sp., Tetradon sp., and Cosmarium sp. were collected from eight of the waterbodies sampled. Eleven species - Sphaerocystis sp., Ulothrix sp., Microspora sp., Scenedesmus quadricauda, Scenedesmus bijuga, Euglena sp., Stephanodiscus sp., Fragitaria sp., Navicula sp., Anomoeneis sp., and Synechococcus aeruginosus were collected from six waterbodies. Thirteen species - Pediastrum boryanum, Ankistrodesmus falcatus, Closteriopsis longissima, Scenedesmus sp., Closterium sp., Cyclotella sp., Diatomella sp., Ophephora sp., Cymbella sp., Surirella sp., Aphanocapsa sp., Oscillatoria sp., and Anabaena sp. were collected from five waterbodies.

Other than appearing to be a fairly normal distribution for an area such as the Refuge, it is interesting to note that Scenedesmus quadricauda was reported in the three largest groups of algae. According to Eisler's publication on polychlorinated biphenyls (PCB's), the presence of PCB's tends to cause reductions in the presence and numbers of the above algae. Scenedesmus quadricauda was found at seven of the nine stations and was among the more numerous algae in samples where it was found.

B. Invertebrates

Invertebrates were identified from collections made during 1987 augmented by supplemental collections during 1988 to describe the populations found at the several stations. The results of this effort are summarized in Table 4. Additionally, the individual data sheets and a phylogentic list of the collected species can be found in Appendix B.

Of the 49 species (or groups of similar species), the most numerous were the aquatic earthworms found at 19 stations encompassing eight of the waterbodies. Gammarus sp. and midge larvae were found at 18 and 21 stations representing seven waterbodies. No invertebrates were found in the sample from the South Spring Pool. Only two species (or groups of similar species) were found in samples from the North Spring Pool and May's Point Pool, while just three were found in the sample from Tschache Pool. Not unexpectedly, the greatest number, 39, of species were identified from Black Brook.

Given the variable water regime found at the Refuge, the above findings are reasonable.

C. Biological Collections (Fish and Turtles)

Fish [common carp (Cyprinus carpio), brown bullhead (Ictalurus nebulosus), and largemouth bass (Micropterus salmoides)] and turtles were collected during 1987 and submitted for analyses in 1988 in order to establish both baseline values and potential problems. The result of this effort is summarized in Tables 5 through 8. Additionally, the individual data sheets and records of analyses can be found in Appendix C. Tables 5 and 6 provide information on metals while Tables 7 and 8 provide information on organics.

From a review of the literature it would appear that the values reported for metals are consistent with background levels for the northeast United States. The only values for organics which appear elevated are for snapping turtles ST-87-7/fat=11.0 ppm and ST-87-9/fat=6.0 ppm for PCB Aroclor 1260. Both of these values are well below the background concentration of 633.0 ppm reported by Eisler for fat in Lake Ontario samples. Some snapping turtles travel more than 0.3 miles to nest and at least one is reported to have traveled 10 miles (Obbard and Brooks, 1980), thus raising the question of the origin of the PCBs, considering that the other turtles showed much lower levels.

D. Sediments

Sediment samples were collected in 1987 and submitted for analyses in 1988. A summary of the samples is found in Appendix D. 1. The results of the analyses are found as follows:

1.	Metals	Appendix D.2
2.	Organochlorines	Appendix D.3
3.	Aliphatics and Aromatic Hydrocarbons	Appendix D.4

The above results are summarized for metals in Table 9 and organics in Table 10.

Background levels were exceeded in eight instances based on information provided by the USEPA (1986), Eisler (1985a, 1985b, 1985c, 1986a, 1986b, 1987, 1988), Shacklette (1984), Aquatic Science (1989), and Connor and Shacklette (1975). Two reported values for manganese, both from Black Brook, exceeded background values (Shacklette and Boergnen, 1984); however, it is not known to cause problems. Three reported values for iron exceeded background values (Shacklette and Boergnen, 1984), but it is naturally high in this area. Iron is not known to cause problems (USEPA, 1986). Five reported values exceeded background values for beryllium, based on Shacklette's value for upper New York State. Twelve of the reported values for copper exceeded background values given by Connor and Shacklette (1984). It is also indicated that copper does not bioconcentrate very much and that potential problems decrease based on the hardness of the water. Fourteen of the reported values for nickel, 16 for zinc, and 17 for lead exceeded the background values listed by Shacklette and Boergnen (1984). Again, it does not appear that any of these poses a problem. Eighteen of the values for selenium exceeded the background value for upper New York given by Shacklette and Boergnen (1984), but were less than the upper limit indicated by Eisler (1985c). In this case, there is no strong evidence for a problem.

Of the 40 organics for which the 20 samples were analyzed, only 15 provided any kind of value and these at less than half the stations. None of the reported values indicated cause for concern.

E. Water Quality

Water quality parameters (carbonates, chlorides, sulfates, and suspended solids from 1987, and air temperature, water temperature, water transparency, water depth, dissolved oxygen, pH, and conductivity in 1988) were collected from stations located on the Refuge and Black Brook. The results of this effort are summarized in Tables 11 through 13. Detailed information is found in Appendix E.

Values found fall within the expected ranges based on information reported in the literature (USEPA, 1986, American Public Health Association, 1971). Several readings for pH are at or slightly above the 9.0 upper limit for fish, with two recorded values of 9.7 (Tschache Pool-July and September). Of the 206 reading for dissolved oxygen, only 10 fell below 4.0 ppm, with most well above 5.0 ppm. Considering that the Refuge serves as a resting and feeding area for large numbers of waterfowl, the above reported levels are reasonable.

VI. CONCLUSIONS

The Montezuma National Wildlife Refuge, White Brook, and Black Brook are home to more than 84 different algae and 49 different invertebrates, in addition to numerous mammals, avians, fish, reptiles and amphibians.

Fish and snapping turtles were analyzed for the presence of 14 metals and 32 organics. None of the reported values are reason for concern.

Sediment samples were analyzed for the presence of the same 14 metals and the same 32 organics. While several of the metals exceeded reported background levels, either they are not known to cause problems - manganese, are naturally high in the area - iron, or otherwise explainable. Copper values may be the result of early attempts to control vegetation and nickel, and lead and zinc from the recreational hunting which takes place. This latter may also account for part of the copper values.

The values reported for the water quality parameters appear to be in line with the expected. About one-third of the 206 pH readings were above 9.0, but only four exceeded 9.4; however, Ruttner (1963) indicates that, "in special cases, such as sunlit pools with luxuriant submersed vegetation, the decomposition of bicarbonate can proceed up to the formation of hydroxide and the pH can be raised up to about 11." Only 5% of the 206 readings for dissolved oxygen (DO) were below 4.0 ppm. Given the conditions present at most of the stations, lower DO readings would be expected in the absence of sunlight.

Hence, the information provided by this report provides a baseline against which future changes can be measured.

Table 3. Montezuma NWR Contaminant Study, 1987 & 1988 Summary of Algae by Station & Water Body

WATERBODY	WHITE BROOK	BLACK BROOK								TSCHACHE POOL					MAYS POINT	MAIN POOL						EAST POOL	N.SPR. POOL	S.SPR. POOL	CAYUGA/SENECA CANAL	
SPECIES / STATION	#1	#3	#2	#BB6	#BB5	#BB4	#BB3	#BB2	#BB1	#4	#5	#6	#7	#8	#14	#9	#10	#11	#12	#13	#15	#16	#19	#20	#17	#18
Gloeocystis sp.	X							X	X	X	X	X	X		X			X				X		X	X	X
Sphaerocystis sp.	X	X	X										X	X	X	X	X	X	X	X	X	X			X	X
Elakatothrix sp.																										X
Binuclearia sp.															X									X	X	
Hormidium sp.																								X		
Ulothrix sp.		X	X			X									X				X	X		X	X	X		X
Microspora sp.			X							X	X	X	X		X				X	X	X		X			X
Cladophora sp.			X	X																			X			
Rhizoclonium sp.									X																	
Schizomeris sp.	X													X								X	X			
Pediastrum simplex	X		X							X			X	X	X	X	X	X	X	X	X		X	X	X	X
Pediastrum boryanum	X		X							X			X	X	X	X	X	X	X	X	X		X	X	X	X
Pediastrum duplex																					X		X		X	
Pediastrum tetras																X					X					
Pediastrum sps.	X	X	X							X			X	X	X	X	X	X	X	X	X					
Ankistrodesmus falcatus	X	X	X						X	X	X	X	X	X	X	X	X	X	X				X			
Cerasterias staurastroides												X		X	X	X	X			X						
Closteriopsis longissima			X			X				X	X	X	X	X	X	X	X	X	X	X	X		X		X	X
Kirchneriella sp.													X													
Selenastrum sp.												X	X	X	X	X					X					
Tetradon sps.	X	X											X	X	X	X	X	X	X	X			X	X	X	X
Botryococcus sudeticus																										X
Golenkinia sp.																					X					X
Actinastrum sp.															X	X	X			X			X			
Crucegenia rectangularia																							X			
Crucegenia sp.		X	X									X														
Scenedesmus quadricauda	X	X	X							X	X	X	X	X	X	X	X	X	X	X			X		X	X
Scenedesmus arcuatus																							X			
Scenedesmus bijuga	X		X			X				X	X	X	X	X	X	X	X			X			X		X	
Scenedesmus abundans																									X	
Scenedesmus dimorphus	X		X							X	X	X	X	X	X	X	X	X	X	X	X					
Scenedesmus sps.	X		X							X				X			X				X	X			X	
Spirogyra sp.																						X			X	
Closterium sp.							X								X					X			X		X	X
Cosmarium sp.		X				X						X			X	X	X			X		X	X	X	X	X
Desmidium sp.				X	X				X												X		X			
Euastrum sps.															X	X	X				X					
Arthrodesmus sp.																					X					X
Staurastrum sp.															X	X	X		X		X				X	X
Pleurotaenium sp.																										X
Netrium sp.																					X			X		
Euglena sps.	X	X	X			X			X						X	X	X	X		X	X		X	X	X	X
Phacus sps.	X	X	X															X		X			X			X
Trachelomonas sps.																						X	X		X	X
Ceratium sp.										X		X									X					
Glenodinium sp.															X								X			

Table 3. Continued

WATERBODY	WHITE BROOK	BLACK BROOK								TSCHACHE POOL					MAYS POINT	MAIN POOL							EAST POOL	N.SPR. POOL	S.SPR. POOL	CAYUGA/SENECA CANAL	
SPECIES / STATION	#1	#3	#2	#BB6	#BB5	#BB4	#BB3	#BB2	#BB1	#4	#5	#6	#7	#8	#14	#9	#10	#11	#12	#13	#15	#16	#19	#20	#17	#18
Mallomonas sp.															X									X	X	X
Dinobryon sp.	X								X														X			X
Cyclotella sp.			X									X		X		X	X			X	X	X	X	X		
Melosira sp.							X							X			X			X	X					X
Stephanodiscus sp.				X								X				X		X	X	X	X		X			X
Pleurogaster sp.		X																					X			
Characiopsis sp.	X	X																			X					
Ophiocytium sp.	X																				X	X				
Diatomella sp.															X					X	X	X	X	X		X
Opephora sp.	X	X	X	X		X		X													X	X	X			X
Asterionella sp.																									X	X
Fragilaria sp.	X	X	X			X		X		X									X	X	X		X	X		X
Actinella sp.												X	X	X		X	X		X				X		X	X
Frustulia sp.	X	X	X			X		X		X											X		X		X	
Navicula sp.	X	X	X	X	X	X		X		X					X		X		X	X		X		X	X	X
Gyrosigma sp.	X	X						X		X											X				X	
Stauroneis sp.	X	X	X	X													X	X					X		X	X
Anomoeoneis sp.	X			X		X		X		X				X		X	X				X	X		X	X	
Gomphonema sp.							X																			
Gomphoneis sp.							X										X								X	
Cymbella sp.	X	X		X									X			X	X	X			X		X		X	X
Denticula sp.																			X					X	X	X
Nitzschia sp.																				X						
Surirella sp.	X		X	X			X	X									X				X	X		X	X	X
Cymatopleura sp.																						X				
Gomphosphaeria aponina																						X				
Aphanocapsa sp.						X				X						X							X	X	X	X
Chroococcus sp.											X											X	X			X
Synechococcus aeruginosus	X		X										X	X							X		X			X
Arthrospira sp.																								X		
Oscillatoria sp.	X	X	X								X			X		X	X				X			X	X	X
Spirulina sp.															X	X							X			
Anabaena sp.						X						X	X			X	X	X	X	X			X		X	X
Aphanizomenon flos-aquae																X						X				
Aphanizomenon sp.																									X	
Nostoc sp.																										X
Scytonema sp.			X								X													X		
Gleotrichia sp.																										X
TOTAL SPECIES = 84																										
SPECIES PER STATION	28	20	26	9	2	11	10	7	9	14	11	17	17	20	27	28	28	16	18	25	34	18	37	27	33	41
SPECIES PER WATERBODY	28								44					32	27						55	18	37	27		51

Table 4. Montezuma NWR Contaminant Study, 1987 & 1988 Summary of Invertebrate by Station & Water Body

WATERBODY	WHITE BROOK	BLACK BROOK								TSCHACHE POOL					MAYS POINT	MAIN POOL						EAST POOL	N.SPR. POOL	S.SPR. POOL	CAYUGA/SENECA CANAL	
SPECIES / STATION	#1	#3	#2	#BB6	#BB5	#BB4	#BB3	#BB2	#BB1	#4	#5	#6	#7	#8	#14	#9	#10	#11	#12	#13	#15	#16	#19	#20	#17	#18
Hydra sp.						21																				
Dugesia tigrinia				30																						50
Nematode				1	1		2	22	1							5										6
Aquatic earthworm	93	261	170	274	54	114	713	550	280		8		1		1	22		4			71	6	8		30	302
Glossiphonia sp.	4		1			18		1														1				
Helobdella sp.					23	54	1	24														5				1
Leech cocoon				17																1						
Ostracod																		2			2					1
Cladoceran						3	1		1							6		1								
Copepod						3	19		7							4		1								
Asellus sp.	1	15		10	4	13	46	105	563							1						4				1
Gammarus sp.	2	60	1	11	5	28	111	73	235				1		1	2	3	5	1			3			4	151
Cambarus sp.	1							1																		
Water mite						1			1																	1
Stonefly nymph							1																			
Mayfly nymph						3												1				1				
Dragonfly larvae																									1	2
Grasshopper adult																					1	1				
Terrestrial aphid																					1					
Gerris sp.																					4					
Water boatman adult					2		4																			
Mesovelia mulsanti																					3					
Caddisfly larvae																1										
Hydropsyche sp.				67		7																				
Hydroptilis sp.				39																		1				
Brachycentrus sp.				4																						
Aquatic caterpillar																						5				
Terrestrial bettle adult								1																		
Elmid larvae				7																	1					
Elmid adult				5	15	10	1																			
Haliolus sp.		13	1	15																		7				
Psephenus herricki				2																						
Weevil						1																				
Cranefly larvae				2																						
Blackfly pupae				1																						
Midge larvae	25	277	47	437	130	307	624	77	7	1	3	2	2			28		1		6	16	20	4		220	94
Midge pupae				49																						
Midge adult				2			5		1												1					
Biting midge					1			4	1																2	3
Soldier fly					1																					
Musta domestica																				1						
Physa sp.						3			3													29			1	4
Heliosoma sp.				1				1	3													3				
Orb snail								3	3																1	3
Roundmouth snail		1				1																				
Ferrissia sp.	1					3																				4
Bithynia tentaculata																						15				2
Sphaerium sp.	1		2	10		1	1	1	2													1				1
Tadpole				2																						
TOTAL SPECIES = 49																										
SPECIES PER STATION	8	6	6	21	10	17	14	13	14	1	2	1	3	0	2	8	1	7	1	3	9	15	2	0	7	16
SPECIES PER WATERBODY	8								39				3	2							18	15	2	0		16

Table 5. Montezuma NWR Contaminant Study, 1987 Biological Collection (Fish) Metals Analysis Results (Catalog 5526) (ppm) (Dry Weight)

WATERBODY	BLACK BROOK	TSCHACHE POOL			MAIN POOL					EAST POOL	CAYUGA/SENECA CANAL	
STATION	3	4 & 6	5	7 & 8	9	9	10	11	12 & 13	16	17	18
SAMPLE TYPE	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB
ELEMENT / SAMPLE ID	CC-87-2	BB-87-1	CC-87-1	CC-87-3	BB-87-2	CC-87-4	CC-87-5	CC-87-6	BB-87-3	BB-87-4	LB-87-1	LB-87-2
Aluminum (AL)	235	141	43.9	55.8	83.7	66.5	215	48.9	115	76.8	25	14
Beryllium (BE)	0.01	<0.01	<0.01	<0.01	<0.01	0.02	0.03	0.03	<0.01	<0.01	0.03	0.02
Cadmium (CD)	0.18	0.06	<0.04	0.16	0.04	0.20	0.1	0.06	0.06	0.05	0.1	0.06
Chromium (CR)	1.1	0.75	1.3	<0.2	0.96	0.4	0.78	0.4	1.7	0.94	0.6	<0.2
Copper (CU)	7.29	3.52	3.19	2.99	3.40	5.05	3.29	2.30	2.38	3.45	1.1	1.3
Iron (FE)	322	245	122	144	249	155	200	123	276	176	61.8	43.3
Manganese (MN)	23.4	97.3	7.33	8.86	16.6	8.37	4.2	2.9	10.2	4.4	1.1	1.4
Nickel (NI)	0.7	0.7	0.76	<0.3	20.0	0.6	0.6	0.4	1.2	0.9	<0.3	<0.3
Lead (PB)	0.6	1.0	<0.5	<0.5	0.7	<0.5	<0.5	<0.5	0.6	<0.5	<0.5	<0.5
Thallium (TL)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zinc (ZN)	241	96.7	254	308	90.2	290	256	212	83.2	62.2	48.0	50.5
Selenium (SE)	1.1	0.97	0.67	0.76	0.80	0.93	1.0	1.0	0.89	1.7	1.2	1.4
Mercury (HG)	0.595	0.020	0.039	0.83	0.10	0.23	0.023	0.020	0.040	0.18	0.645	0.770
Arsenic (AS)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.58

Notes: WB = Whole Body CC = Common Carp BB = Brown Bullhead LB = Largemouth Bass

Table 6. Montezuma NWR Contaminant Study, 1987 Biological Collection (Turtles) Metals Analysis Results (Catalog 5526) (ppm) (Dry Weight)

WATERBODY	TSCHACHE POOL											
STATION	6				6				POOL COMPOSITE			
SAMPLE TYPE	Fat	Egg	Liver	Muscle	Fat	Egg	Liver	Muscle	Fat	Egg	Liver	Muscle
ELEMENT / SAMPLE ID	STF-87-1	STE-87-1	STL-87-1	STM-87-1	STF-87-3	STE-87-3	STL-87-3	STM-87-3	STF2-87-1	STE2-87-1	STL2-87-1	STM2-87-1
Aluminum (AL)	14	3.9	13	22	28	13	23	40.0	17	3.7	16	22
Beryllium (BE)	<0.02	<0.01	<0.01	<0.01	0.031	<0.01	<0.01	<0.01	<0.02	<0.01	0.03	<0
Cadmium (CD)	<0.03	0.04	0.05	<0.03	<0.03	0.04	0.04	<0.04	<0.05	0.03	0.1	<0
Chromium (CR)	0.3	0.5	0.43	3.4	<0.2	1.3	1.0	0.94	1.2	0.4	0.48	3
Copper (CU)	<0.03	2.0	3.92	1.5	<0.02	1.5	3.19	1.3	20.04	2.1	4.71	1
Iron (FE)	16	44.2	1260	80.0	16.9	45.2	684	97.5	21.9	53.6	1040	117
Manganese (MN)	0.15	1.3	5.0	0.76	0.27	0.72	6.52	1.1	0.18	1.9	7.48	1
Nickel (NI)	<0.2	<0.3	<0.3	0.5	<0.3	0.5	0.4	0.7	<0.3	<0.3	<0.3	2
Lead (PB)	<0.7	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.9	<0.5	<0.5	<0
Thallium (TL)	<0.8	<0.4	<0.7	<0.7	<0.4	<0.4	<0.7	<0.7	<1.0	<0.5	<0.8	<1
Zinc (ZN)	2.0	65.8	106	171	3.50	74.6	113	178	3.7	80.2	122	18
Selenium (SE)	0.2	1.0	1.5	0.55	<0.1	0.5	2.0	0.53	<0.2	0.96	2.7	
Mercury (HG)	.005	.010	.140	.027	.005	.023	.390	.049	.015	.032	.625	
Arsenic (AS)	0.2	<0.2	0.4	<0.2	0.3	<0.2	<0.2	<0.2	<0.1	0.2	0.3	<0

WATERBODY	MAIN POOL											
STATION	E. Edge				E. Edge				E. Edge			
SAMPLE TYPE	Fat	Egg	Liver	Muscle	Fat	Egg	Liver	Muscle	Fat	Egg	Liver	Muscle
ELEMENT / SAMPLE ID	STF-87-6	STE-87-6	STL-87-6	STM-87-6	STF-87-4	STE-87-4	STL-87-4	STM-87-4	STF-87-7	STE-87-7	STL-87-7	STM-87-7
Aluminum (AL)	2.8	5.8	16.0	49.7	14	3.9	14	12	5.8	5.6	5.2	1
Beryllium (BE)	<0.02	<0.01	0.01	<0.01	0.042	<0.01	0.02	<0.01	<0.02	<0.01	0.01	<0
Cadmium (CD)	<0.05	<0.04	0.06	0.6	<0.03	<0.03	0.08	<0.04	<0.05	<0.03	<0.03	<0
Chromium (CR)	<0.2	0.3	0.2	0.50	0.3	0.5	0.2	1.3	<0.2	0.3	0.62	0
Copper (CU)	<0.04	1.0	2.0	0.91	<0.02	1.7	2.4	1.9	<0.04	2.42	2.82	1
Iron (FE)	6.0	42.7	682	102	5.8	49.9	389	119	18	41.2	238	8
Manganese (MN)	<0.05	1.3	4.5	0.73	0.07	1.1	3.6	0.70	0.09	1.5	3.2	0
Nickel (NI)	<0.3	<0.3	0.3	<0.3	<0.3	<0.3	<0.3	0.6	<0.3	<0.3	<0.3	0
Lead (PB)	<0.9	<0.5	<0.4	<0.4	<0.5	<0.4	<0.4	<0.4	<0.9	<0.4	<0.4	<0
Thallium (TL)	<1.0	<0.5	<0.7	<0.7	<0.5	<0.4	<0.7	<0.7	<1.0	<0.4	<0.7	<0
Zinc (ZN)	1.5	68.4	84.8	178	1.4	77.2	66.0	221	3.6	53.9	52.9	17
Selenium (SE)	<0.2	1.0	3.3	1.2	<0.2	1.3	1.3	0.68	<0.2	1.2	1.3	0
Mercury (HG)	.019	.110	.992	.290	.004	.037	.250	.210	.007	.065	.270	
Arsenic (AS)	<0.2	<0.2	0.3	<0.2	<0.1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0

WATERBODY	MAIN POOL								EAST POOL			
STATION	NE Corner				NE Corner				16			
SAMPLE TYPE	Fat	Egg	Liver	Muscle	Fat	Egg	Liver	Muscle	Fat	Egg	Liver	Muscle
ELEMENT / SAMPLE ID	STF-87-5	STE-87-5	STL-87-5	STM-87-5	STF-87-8	STE-87-8	STL-87-8	STM-87-8	STF-87-9	STE-87-9	STL-87-9	STM-87-9
Aluminum (AL)	9.4	5.0	6.4	37.1	6.3	8.6	4.4	13	0.7	4.5	8.7	1
Beryllium (BE)	0.042	<0.01	0.01	<0.01	0.041	<0.01	0.01	<0.01	0.039	<0.01	<0.01	<0
Cadmium (CD)	<0.03	<0.03	0.04	0.05	<0.03	<0.03	0.04	0.04	<0.03	<0.03	0.12	0
Chromium (CR)	<0.2	<0.2	0.34	2.1	<0.2	0.62	0.2	0.69	<0.2	0.64	0.45	1
Copper (CU)	<0.02	1.7	2.43	2.0	<0.02	1.7	1.6	1.5	<0.02	1.4	2.2	1
Iron (FE)	12.4	48.0	209	128	8.8	37.6	115	97.9	8.5	46.7	432	116
Manganese (MN)	0.25	1.2	3.4	1.3	0.25	1.9	2.9	0.80	0.1	1.7	5.36	1
Nickel (NI)	<0.3	<0.3	<0.3	1.1	<0.3	<0.3	0.3	0.4	<0.3	0.4	0.89	<0
Lead (PB)	<0.5	<0.4	<0.4	<0.4	<0.4	<0.5	<0.4	<0.4	<0.4	<0.5	<0.4	<0
Thallium (TL)	<0.4	<0.4	<0.7	<0.7	<0.4	<0.5	<0.7	<0.7	<0.4	<0.5	<0.7	<0
Zinc (ZN)	1.8	71.6	60.8	215	2.0	82.6	43.6	186	2.63	94.1	87.7	21
Selenium (SE)	<0.2	1.1	1.1	0.60	<0.2	1.2	0.91	0.62	<0.2	1.1	3.1	0
Mercury (HG)	.008	.042	.330	.210	.008	.027	.110	.047	.025	.170	2.200	
Arsenic (AS)	<0.1	<0.2	<0.2	<0.2	<0.1	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	0

WATERBODY	EAST POOL							
STATION	SE Corner				POOL COMPOSITE			
SAMPLE TYPE	Fat	Egg	Liver	Muscle	Fat	Egg	Liver	Muscle
ELEMENT / SAMPLE ID	STF-87-2	STE-87-2	STL-87-2	STM-87-2	STF4-87-2	STE4-87-2	STL4-87-2	STM4-87-2
Aluminum (AL)	34	2.5	17	29	34	3.5	26	42.7
Beryllium (BE)	0.03	<0.01	<0.01	<0.01	0.06	<0.01	0.01	<0.01
Cadmium (CD)	<0.03	<0.03	0.12	<0.04	<0.07	<0.02	0.15	0.05
Chromium (CR)	5.1	0.61	0.2	1.2	0.98	0.59	0.41	1.8
Copper (CU)	0.67	3.58	7.14	1.7	0.30	3.12	11.1	1.8
Iron (FE)	72.1	46.8	664	104	35.8	54.1	826	108
Manganese (MN)	0.74	1.3	5.85	0.81	0.3	1.0	7.76	1.2
Nickel (NI)	0.4	<0.3	0.3	0.5	<0.7	0.4	0.5	0.6
Lead (PB)	<0.5	<0.4	<0.4	<0.4	<0.1	<0.6	<0.4	<0.4
Thallium (TL)	<0.5	<0.4	<0.7	<0.7	<0.9	<0.5	<0.7	<0.7
Zinc (ZN)	15.3	65.8	119	162	13.8	71.9	134	172
Selenium (SE)	0.5	1.5	3.6	0.87	<0.2	1.1	3.8	0.86
Mercury (HG)	.076	.140	2.300	.220	.029	.072	2.100	.2-0
Arsenic (AS)	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2

Note: ST = Snapping Turtle

Table 7. Montezuma NWR Contaminant Study, 1987 Biological Collection (Fish) Organics Analysis Results (Catalog 5526) (ppm) (Wet Weight)

WATERBODY	BLACK BROOK	TSCHACHE POOL			MAIN POOL					EAST POOL	CAYUGA/SENECA CANAL			
STATION	3	4 & 6	5	7 & 8	9	9	10	11	12 & 13	16	17	17	17(Ave)	18
SAMPLE TYPE	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB
COMPOUND / SAMPLE ID	CC-87-2	BB-87-1	CC-87-1	CC-87-3	BB-87-2	CC-87-4	CC-87-5	CC-87-6	BB-87-3	BB-87-4	LB-87-1	LB-87-1	LB-87-1	LB-87-2
p,p'-DDE	0.04	0.01	0.07	0.03	0.01	0.04	0.01	0.01	0.01	0.01	0.13	0.13	0.13	0.11
p,p'-DDD	0.01	0.01	0.05	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.03
PCB (1254)	0.05		0.08							0.05	0.30	0.31	0.31	0.21
PCB (1260)	0.07			0.05		0.05					0.21	0.25	0.23	0.13
t-Nonachlor											0.02	0.02	0.02	0.02
dieldrin											0.01	0.01	0.01	0.01
fluorene		0.01	0.01	0.01										
phenanthrene		0.01		0.02	0.02		0.01			0.01	0.01	0.01	0.01	
benzo(e)pyrene	0.01				0.01									

Notes: WB = Whole Body CC = Common Carp BB = Brown Bullhead LB = Largemouth Bass

In addition to the values reported above, the samples were analyzed for the following compounds without detection:

HCB	cis-nonachlor
alpha-BHC	o,p'-DDD
gamma-BHC	Endrin
beta-BHC	alpha-Chlordane
delta-BHC	o,p'-DDT
Toxaphene	napthalene
Arochlor 1242	1,2 benzanthracene
Arochlor 1248	benzo(b)fluorananthracene
Hept. Epox.	benzo(a)pyrene
o,p'-DDE	1,2,5,6-dibenzanthracene
oxychlordane	

Table 8. Montezuma NWR Contaminant Study, 1987 Biological Collection (Turtles) Organics Analysis Results (Catalog 5526) (ppm) (Wet Weight)

WATERBODY	TSCHACHE POOL											
STATION	6				6				POOL COMPOSITE			
SAMPLE TYPE	Fat	Egg	Liver	Muscle	Fat	Egg	Liver	Muscle	Fat	Egg	Liver	Muscle
COMPOUND / SAMPLE ID	STF-87-1	STE-87-1	STL-87-1	STM-87-1	STF-87-3	STE-87-3	STL-87-3	STM-87-3	STF2-87-1	STE2-87-1	STL2-87-1	STM2-87-1
p,p'-DDE	0.25	0.01	0.05		0.10				0.61	0.06	0.09	
p,p'-DDD												
PCB (1254)			0.61				0.24			0.39	1.00	
PCB (1260)	3.5		0.50		3.3		0.23		3.40	0.24	0.85	
t-Nonachlor	0.07		0.01		0.02				0.07		0.02	
dieldrin	0.02				0.02				0.06			
fluorene												
phenanthrene	0.10	0.02			0.07	0.01	0.02	0.01	0.08		0.01	0.01
benzo(e)pyrene	0.01		0.01		0.01	0.01						
HCB	0.01								0.01			
oxychlordane	0.13				0.02				0.07	0.01		
cis-nonachlor	0.04				0.02				0.03			
mirex	0.02				0.01				0.02			
napthalene	0.02	0.02	0.01	0.01	0.03	0.01	0.02			0.01	0.01	0.01
pyrene		0.01	-	0.01	0.01							
benzo(g,h,i)perylene	0.01				0.01							
fluoranthrene					0.01	0.01			0.01			
1-2-benzoanthracene				0.01	0.01				0.01		0.01	
anthracene		0.01										
chrysene				0.01								0.01

WATERBODY	MAIN POOL															
STATION	E. Edge						E. Edge				E. Edge					
SAMPLE TYPE	Fat	Egg	Egg	Ave. Egg	Liver	Muscle	Fat	Egg	Liver	Muscle	Fat	Egg	Liver	Muscle		
COMPOUND / SAMPLE ID	STF-87-6	STE-87-6	STE-87-6	STE-87-6	STL-87-6	STM-87-6	STF-87-4	STE-87-4	STL-87-4	STM-87-4	STF-87-7	STE-87-7	STL-87-7	STM-87-7		
p,p'-DDE	0.26	0.08	0.08	0.08	0.11		0.71	0.05	0.13		1.0	0.02	0.06			
p,p'-DDD	0.02						0.04				0.06					
PCB (1254)		0.67	0.70	0.69	1.00				0.63				0.23			
PCB (1260)	1.0	0.33	0.36	0.35	0.93		1.2		0.22		11.0		0.17			
t-Nonachlor	0.03				0.02		0.02		0.06		0.24		0.06			
dieldrin											0.05					
fluorene																
phenanthrene	0.08	0.03	0.02	0.03			0.08	0.02	0.01	0.01	0.11		0.03	0.01		
benzo(e)pyrene	0.01										0.02	0.01				
HCB											0.01					
oxychlordane	0.01	0.03	0.03	0.03			0.03				0.14					
cis-nonachlor	0.01						0.01				0.08					
mirex											0.08					
napthalene	0.02	0.01	0.01	0.01		0.01	0.06	0.01	0.01	0.01	0.04	0.02	0.01			
pyrene	0.01											0.01	0.01			
benzo(g,h,i)perylene				-										0.01		
fluoranthrene	0.01						0.01	0.01								
1-2-benzoanthracene											0.01			0.01		
anthracene																
chrysene	0.01										0.01	0.01	0.01			

Note: ST = Snapping Turtle

In addition to the values reported above, the samples were analyzed for the following compounds without detection:

alpha-BHC	Arochlor 1248	o,p'-DDT
gamma-BHC	Hept. Epox.	benzo(b)fluorananthracene
beta-BHC	o,p'-DDE	benzo(k)fluoranantiracene
delta-BHC	o,p'-DDD	benzo(a)pyrene
Toxaphene	Endrin	1,2,5,6-dibenzanthracene

Table 8. (Cont'd.)

WATERBODY	MAIN POOL											
STATION	NE Corner							NE Corner				
SAMPLE TYPE	Fat	Egg	Liver	Muscle	Fat	Fat	Ave. Fat	Egg	Liver	Liver	Ave. Liver	Muscle
COMPOUND / SAMPLE ID	STF-87-5	STE-87-5	STL-87-5	STM-87-5	STF-87-8	STF-87-8	STF-87-8	STE-87-8	STL-87-8	STL-87-8	STL-87-8	STM-87-8
p,p'-DDE	0.11	0.01	0.03		0.20	0.20	0.20	0.02	0.04	0.05	0.05	
p,p'-DDD	0.02				0.02	0.02	0.02					
PCB (1254)			0.48						0.20	0.18	0.19	
PCB (1260)	1.2		0.26		0.73	0.77	0.75		0.15	0.15	0.15	
t-Nonachlor	0.02		0.04		0.02	0.02	0.02					
dieldrin												
fluorene								0.01				0.01
phenanthrene	0.15	0.02			0.11	0.11	0.11	0.02	0.01	0.01	0.01	0.03
benzo(e)pyrene	0.01		0.01					0.01				
HCB					0.01	0.01	0.01					
oxychlordane	0.03				0.02	0.02	0.02					
cis-nonachlor												
mirex												
napthalene	0.02	0.01	0.01	0.01		0.01	0.01		0.01	0.01	0.01	0.03
pyrene												0.01
benzo(g,h,i)perylene	0.01											
fluoranthrene								0.01				
1-2-benzoanthracene	0.01				0.01	0.01	0.01					
anthracene								0.01				
chrysene	0.01							0.01				0.01

WATERBODY	EAST POOL														
STATION	16				SE Corner				POOL COMPOSITE						
SAMPLE TYPE	Fat	Egg	Liver	Muscle	Fat	Egg	Liver	Muscle	Fat	Egg	Liver	Muscle	Muscle	Ave. Muscle
COMPOUND / SAMPLE ID	STF-87-9	STE-87-9	STL-87-9	STM-87-9	STF-87-2	STE-87-2	STL-87-2	STM-87-2	STF4-87-2	STE4-87-2	STL4-87-2	STM4-87-2	STM4-87-2	STM4-87-2
p,p'-DDE	0.49	0.02	0.09		0.10		0.01		0.05					
p,p'-DDD	0.04													
PCB (1254)		0.32	1.2				0.14				0.17			
PCB (1260)	6.0	0.21	0.60		3.3		0.18		1.40		0.12			
t-Nonachlor	0.17		0.02		0.02				0.02					
dieldrin	0.06				0.02				0.02					
fluorene		0.01												
phenanthrene	0.14	0.01	0.01	0.02	0.04	0.02		0.01	0.06		0.01	0.01	0.01	0.01
benzo(e)pyrene			0.01						0.01		0.01			
HCB	0.01				0.01				0.01					
oxychlordane	0.08				0.03				0.03					
cis-nonachlor	0.07				0.02									
mirex	0.02				0.01				0.02					
napthalene	0.01		0.01	0.01	0.02	0.01			0.02	0.01	0.01	0.01	0.01	0.01
pyrene						0.01			0.01					
benzo(g,h,i)perylene														
fluoranthrene		0.01			0.01				0.01					
1-2-benzoanthracene	0.01								0.01					
anthracene										0.01				
chrysene							0.01							

Note: ST = Snapping Turtle

In addition to the values reported above, the samples were analyzed for the following compounds without detection:

alpha-BHC	Arochlor 1248	o,p'-DDT
gamma-BHC	Hept. Epox.	benzo(b)fluorananthracene
beta-BHC	o,p'-DDE	benzo(k)fluoranthracene
delta-BHC	o,p'-DDD	benzo(a)pyrene
Toxaphene	Endrin	1,2,5,6-dibenzanthracene

Table 9. Montezuma NWR Contaminant Study, 1988 Sediment Analysis for Metals (Catalog 88-5-111A) (ppm) (Dry Weight)

WATERBODY		WHITE BROOK	BLACK BROOK		TSCHACHE POOL					MAYS POINT	MAIN POOL		
STATION #		1	2	3	4	5	6	7	8	14	9	10	11
ELEMENT	SYM.												
Silver	AG	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Aluminum	AL	9600	15900	16100	21700	30400	35300	21000	13900	18500	18500	37300	39900
Boron	B	9.8	9.0	17	27	28	40	28	29	19	18	26	35
Barium	BA	45.2	73.8	74.3	98.9	137	56.0	102	69	92.0	103	82.9	204
Beryllium	BE	0.53	0.72	0.79	0.88	1.3	1.3	0.86	0.61	0.79	0.78	1.6	1.5
Cadmium	CD	0.6	0.4	<0.2	1.4	0.90	1.2	1.0	1.6	0.94	0.6	0.6	0.2
Chromium	CR	11	19	18	23	32	17	15	15	20	19	40	15
Copper	CU	11	17	13	35.2	44.6	37.2	25.7	24.4	29.9	27.7	50.5	28
Iron	FE	12800	19000	16800	24200	29900	25600	14800	14400	17400	16400	20000	18400
Magnesium	MG	5210	12700	13400	6050	8150	7360	5410	4480	6200	8160	5700	6880
Maganese	MN	266	453	408	261	309	234	171	170	209	214	161	124
Molybdenum	MO	<2	<2	<2	<3	<3	3	<2	<2	<2	<2	<2	<2
Nickel	NI	8.5	19	14	22	24	24	17	16	19	16	29	25
Lead	PB	10	17	10	54	36	50	41	56	31	31	41	23
Selenium	SE	0.1	0.48	0.3	1.9	1.5	2.0	1.7	1.9	1.6	1.5	2.5	1.1
Strontium	SR	44.9	111	124	209	190	192	286	227	212	310	206	112
Thallium	TL	<4	<4	<4	<4	<4	<5	<5	<4	<4	<4	<5	<5
Vanadium	V	17	23	23	30	37	49.7	29	23	24	26	45.7	49.0
Zinc	ZN	41.5	100	101	120	124	120	75.1	106	80.1	86.1	76.9	83.5
Mercury	HG	0.02	0.068	0.045	0.20	0.18	0.17	0.16	0.20	0.19	0.14	0.10	0.066
Arsenic	AS	1.8	3.0	2.2	3.0	2.8	3.6	1.4	2.5	2.3	2.1	2.7	1.1

WATERBODY		MAIN POOL			EAST POOL	N. SPRING POOL	S. SPRING POOL	CAYUGA/SENECA CANAL		DETECTION LIMIT	REC. DETECT. LIMIT
STATION #		12	13	15	16	19	20	17	18		
ELEMENT	SYM.										
Silver	AG	<2	<2	<2	<2	<2	<2	<2	<2	2	5
Aluminum	AL	9260	9390	14800	26300	6570	3620	10200	3870	3	
Boron	B	20	20	15	28	71.0	66	12	4.0	2-5	
Barium	BA	72.2	53.8	84.8	76.9	38.1	34.6	50.0	26.5	0.1	
Beryllium	BE	0.3	0.44	0.61	1.1	0.3	0.1	0.51	0.2	0.1-0.2	
Cadmium	CD	1.1	1.5	<0.2	1.5	0.95	1.2	2.6	0.3	0.2-0.3	2.5
Chromium	CR	13	11	7.0	32	7.5	3.3	16	5.4	1	5
Copper	CU	25	23	12.0	49.5	13.0	6.5	21	4.5	0.2-0.3	25
Iron	FE	17900	16000	14400	16700	6210	2810	9970	3830	1	50
Magnesium	MG	3300	3040	16800	5270	4540	2530	10900	4870	0.1-6.0	
Maganese	MN	136	109	288	133	189	152	133	79.2	0.2-0.8	7.5
Molybdenum	MO	<2	<2	<2	3	<1	<1	<2	<1	1-3	
Nickel	NI	20	18	9.6	25	8.2	4.0	10	4.0	2-3	20
Lead	PB	52	55	9.0	26	48	34	20	6.0	4-5	
Selenium	SE	2.1	2.1	0.36	2.7	1.1	0.92	0.3	<0.1	---	2.5
Strontium	SR	175	240	97.1	180	522	852	31.3	51.0	0.1-0.2	
Thallium	TL	<4	<4	<4	<4	<4	<4	<4	<4	4-5	5
Vanadium	V	13	14	24	38.4	11.0	6.0	16	6.6	0.3-0.7	
Zinc	ZN	109	103	39.5	174	77.6	46.8	219	27.7	0.2-0.3	20
Mercury	HG	0.19	0.19	0.02	0.18	0.12	0.072	0.13	<0.02	---	0.1
Arsenic	AS	4.3	3.8	2.3	4.3	1.5	1.1	1.8	0.5	---	5

Table 10. Montezuma NWR Contaminant Study, 1988 Sediment Analysis for Organochlorines and Polynuclear Aromatic Hydrocarbons (Catalogs 88-5-111A & 88-5-111B) (ppm) (Wet Weight)

WATERBODY		BLACK BROOK	TSCHACHE POOL			MAYS PT. POOL	MAIN POOL		EAST POOL	N.SPRING POOL	CAYUGA/SENECA CANAL
COMPOUND	STATION	3	4	5	8	14	9	12	16	19	17
p,p'-DDE											0.01
napthalene					0.01		0.02				
fluorene							0.03				
phenanthrene					0.02		0.22				
anthracene			0.01				0.06				
fluoranthrene			0.03	0.02	0.02	0.01	0.34		0.01	0.01	
pyrene			0.02	0.01	0.01		0.27			0.01	
1-2-benzanthracene		0.01		0.01	0.01		0.17	0.01	0.01		
chrysene			0.01	0.01	0.01	0.02	0.11	0.02	0.03		
benzo(b)fluoranthrene			0.02	0.02	0.01	0.01	0.10	0.02	0.01	0.01	
benzo(k)fluoranthrene			0.01				0.06				
benzo(e)pyrene			0.03	0.01	0.01		0.08	0.03		0.01	
benzo(a)pyrene			0.03	0.02	0.01	0.01	0.12		0.01	0.01	
1,2,5,6-dibenzanthracene			0.01	0.01		0.03	0.05				
benzo(g,h,i)perylene			0.04	0.03	0.01	0.01	0.08	0.01	0.01	0.01	

Sediment samples from all 20 stations were analyzed for organochlorines. Only the above samples were analyzed for polynuclear aromatic hydrocarbons. None of the following organochlorines were detected.

HCB	Toxaphene	o,p'-DDD
alpha-BHC	Arochlor 1242	Endrin
gamma-BHC	Arochlor 1248	cis-nonachlor
beta-BHC	Arochlor 1254	o,p'-DDT
delta-BHC	Arochlor 1260	p,p'-DDD
Oxychlordane	o,p'-DDE	p,p'-DDT
Hept. Epox.	alpha-Chlordane	Mirex
r-Chlordane	p,p'-DDE	
t-Nonachlor	Dieldrin	

Table 11. 1988 Montezuma National Wildlife Refuge Contaminant Study
1988 Black Brook Water Quality (June 7).

Station # on Black Brook	1BB	2BB	3BB	4BB	5BB	6BB
Air Temp. °C	19.5	13.5	17.0	12.0	13.0	11.0
Water Temp. °C	13.0	17.0	17.0	15.0	15.0	16.0
Water Depth Inches	12.0	18.0	24.0	12.0	18.0	12.0
Secchi Disc Inches	12.0	18.0	24.0	12.0	18.0	12.0
Dissolved Oxygen Parts Per Million	6.0	5.0	8.0	4.0	5.0	10.0
Conductivity (Corr to 25°C) uohms	NS	NS	NS	NS	NS	NS
pH	9.0	9.1	9.1	8.4	9.0	9.1
Total Coliform #/100 ml	NS	NS	NS	NS	NS	NS

Table 12. 1988 Montezuma National Wildlife Refuge Contaminant Study
Water Quality Monitoring Results Summary

Station #	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	17.0	13.8	23.0	26.0	23.0	20.0	5.0	5.0
Water Temp. °C	14.6	11.1	20.5	23.0	20.0	17.0	8.0	5.0
Water Depth Inches	9.0	17.0	8.0	3.0	3.0	5.0	12.0	22.0
Secchi Disc Inches	9.0	17.0	8.0	3.0	3.0	5.0	12.0	22.0
Dissolved Oxygen Parts Per Million	10.3	5.9	3.0	10.6	4.96	3.91	6.44	10.30
Conductivity (Corr to 25°C) µohms	1726	1549	1800	2000	2200	1600	1500	1300
pH	7.6	8.0	8.9	6.82	4.70	7.59	7.47	7.09
Total Coliform #/100 ml	NS	NS	187	667	853	2000	1500	1500

Station #	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	22.2	13.2	25.0	26.5	24.0	18.00	5.0	5.0
Water Temp. °C	17.7	10.8	23.5	23.0	22.0	17.0	8.0	5.0
Water Depth Inches	7.0	9.0	6.0	6.0	6.0	6.0	4.0	12.0
Secchi Disc Inches	7.0	9.0	6.0	6.0	6.0	6.0	4.0	12.0
Dissolved Oxygen Parts Per Million	13.8	10.8	9.0	10.8	2.91	6.50	12.00	10.98
Conductivity (Corr to 25°C) µohms	1981	1470	2400	3600	2500	15	1700	1500
pH	8.3	8.0	9.18	5.73	6.83	7.94	8.02	7.08
Total Coliform #/100 ml	NS	NS	553	1330	1433	800	120	447

Table 12. Cont'd.

Station #3 Black Brook	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	23.5	13.2	20.0	26.0	23.0	18.0	5.0	5.0
Water Temp. °C	22.4	11.3	22.0	24.0	25.0	18.0	7.0	4.0
Water Depth Inches	13.0	16.0	24.0	12.0	12.0	12.0	8.0	13.0
Secchi Disc Inches	13.0	16.0	12.0	12.0	12.0	12.0	8.0	13.0
Dissolved Oxygen Parts Per Million	10.7	12.2	4.5	8.3	5.95	6.39	11.66	11.68
Conductivity (Corr to 25°C) µohms	1969	1479	2200	3300	2050	1250	1700	1300
pH	7.9	8.2	9.09	8.80	7.00	8.04	8.35	7.07
Total Coliform #/100 ml	NS	NS	253	681	1227	>2000	>1500	>1500

Station #4 Tschache Pool	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	22.5	14.8	30.0	36.0	23.0	20.0	8.0	6.5
Water Temp. °C	22.1	11.7	29.0	30.0	24.0	20.0	9.5	4.0
Water Depth Inches	33.0	37.0	36.0	30.0	18.0	23.0	24.0	26.0
Secchi Disc Inches	17.0	22.0	10.0	8.0	12.0	11.0	12.0	22.0
Dissolved Oxygen Parts Per Million	10.6	12.0	13.0	10.6	7.06	12.60	10.16	13.12
Conductivity (Corr to 25°C) µohms	865	903	1200	1200	1300	800	780	640
pH	8.7	8.6	9.20	9.70	8.63	8.64	8.08	7.06
Total Coliform #/100 ml	NS	NS	33	33	40	40	20	13

Table 12. Cont'd.

Station # 5 Tschache Pool	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	23.1	14.7	26.5	27.0	23.0	19.0	7.0	8.0
Water Temp. °C	21.1	11.3	26.0	29.2	23.0	20.0	9.5	4.0
Water Depth Inches	16.0	22.0	48.0	12.0	8.0	12.0	13.0	18.0
Secchi Disc Inches	13.0	16.0	4.0	6.0	4.0	12.0	13.0	12.0
Dissolved Oxygen Parts Per Million	9.2	12.3	10.0	8.70	6.50	10.11	9.82	14.18
Conductivity (Corr to 25°C) µohms	990	923	1200	1200	1420	860	920	940
pH	8.2	8.5	9.05	8.20	7.90	8.11	7.92	7.10
Total Coliform #/100 ml	NS	NS	60	690	140	207	40	13

Station #6 Tschache Pool	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	22.5	14.7	28.0	31.0	23.0	19.0	8.0	7.5
Water Temp. °C	22.2	11.8	28.0	31.5	23.0	20.0	9.5	4.0
Water Depth Inches	17.0	20.0	36.0	14.0	12.0	13.0	12.0	24.0
Secchi Disc Inches	15.0	20.0	6.0	6.0	10.0	10.0	12.0	12.0
Dissolved Oxygen Parts Per Million	7.8	8.9	10.0	15.0	5.46	9.98	9.33	13.02
Conductivity (Corr to 25°C) µohms	937	870	1400	1200	1420	780	860	440
pH	8.1	7.7	9.10	8.35	7.70	9.74	7.83	7.09
Total Coliform #/100 ml	NS	NS	50	73	107	140	40	33

Table 12. Cont'd.

Station #7 Tschache Pool	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	23.3	15.1	31.0	28.0	23.0	20.0	7.0	7.0
Water Temp. °C	22.8	12.0	28.0	33.0	24.0	20.0	9.5	4.0
Water Depth Inches	26.0	31.0	36.0	8.0	18.0	18.0	20.0	18.0
Secchi Disc Inches	11.0	21.0	6.0	6.0	12.0	10.0	3.0	10.0
Dissolved Oxygen Parts Per Million	12.4	12.0	11.0	7.40	6.88	12.29	10.90	12.18
Conductivity (Corr to 25°C) µohms	856	971	1200	1100	1200	770	780	760
pH	9.3	8.6	9.30	9.45	7.92	8.81	8.36	7.06
Total Coliform #/100 ml	NS	NS	30	7*	133*	20	27	0

Station #8 Tschache Pool	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	23.5	15.8	32.0	28.0	23.0	20.0	8.0	7.0
Water Temp. °C	23.5	12.8	29.0	33.0	24.0	21.0	9.5	4.0
Water Depth Inches	14.0	15.0	18.0	8.0	18.0	18.0	18.0	13.0
Secchi Disc Inches	11.0	15.0	10.0	6.0	12.0	14.0	6.0	13.0
Dissolved Oxygen Parts Per Million	13.2	12.2	7.0	7.40	6.88	11.44	11.11	13.08
Conductivity (Corr to 25°C) µohms	1020	1000	1200	1100	1200	760	760	820
pH	9.3	8.6	9.30	9.45	7.92	8.85	8.38	7.05
Total Coliform #/100 ml	NS	NS	130	7*	133*	49	40	67

Table 12. Cont'd.

Station #14 May's Point Pool	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	25.1	14.2	27.0	28.0	24.0	20.0	10.0	7.0
Water Temp. °C	22.9	10.3	26.0	32.0	27.0	19.0	11.0	8.0
Water Depth Inches	10.0	11.0	48.0	36.0	18.0	6.0	5.0	14.0
Secchi Disc Inches	10.0	7.0	8.0	8.0	6.0	6.0	5.0	10.0
Dissolved Oxygen Parts Per Million	13.2	10.4	8.0	11.0	8.93	4.80	10.34	13.04
Conductivity (Corr to 25°C) µohms	896	927	1200	1400	1230	370	740	1000
pH	9.2	8.2	9.08	6.50	8.42	8.13	8.23	7.13
Total Coliform #/100 ml	NS	NS	67	73	287	>2000	100	27

Station #9 Main Pool	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	26.1	11.6	30.5	25.0	26.0	17.0	8.0	8.5
Water Temp. °C	22.3	10.2	29.0	27.0	26.0	18.0	7.0	7.0
Water Depth Inches	11.0	7.0	18.0	2.0	2.0	4.0	6.0	7.0
Secchi Disc Inches	11.0	7.0	3.0	2.0	1.0	4.0	6.0	7.0
Dissolved Oxygen Parts Per Million	8.0	6.2	11.0	5.08	12.59	6.88	10.44	13.27
Conductivity (Corr to 25°C) µohms	845	836	1400	1400	1200	720	740	830
pH	8.1	7.8	9.06	8.09	7.66	8.16	8.09	7.13
Total Coliform #/100 ml	NS	NS	168	507	247	294	480	33

Table 12. Cont'd.

Station #10 Main Pool	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	22.3	11.3	27.0	27.0	24.0	17.0	4.5	8.0
Water Temp. °C	21.2	10.9	27.0	26.5	25.0	18.0	8.0	5.0
Water Depth Inches	26.0	22.0	48.0	18.0	18.0	18.0	18.0	18.0*
Secchi Disc Inches	13.0	14.0	6.0	8.0	3.0	7.0	4.0	4.0*
Dissolved Oxygen Parts Per Million	13.7	9.6	7.00	8.68	10.66	9.21	11.09	11.88
Conductivity (Corr to 25°C) µohms	888	799	1200	1200	1100	740	730	750
pH	9.0	8.6	9.03	7.70	8.87	9.01	8.50	7.13
Total Coliform #/100 ml	NS	NS	8	53	47	21	33	100

Station #11 Main Pool	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	21.8	11.6	30.0	27.0	25.0	18.0	5.0	7.0
Water Temp. °C	19.6	9.8	25.5	25.0	25.8	18.0	9.0	4.0
Water Depth Inches	17.0	13.0	12.0	12.0	6.0	10.0	6.0	10.0
Secchi Disc Inches	14.0	9.0	6.0	12.0	6.0	5.0	6.0	8.0
Dissolved Oxygen Parts Per Million	6.4	5.8	9.50	2.68	9.40	4.87	11.96	13.64
Conductivity (Corr to 25°C) µohms	669	751	1200	1300	1220	760	770	810
pH	7.6	7.4	8.81	7.07	7.38	7.17	8.45	7.10
Total Coliform #/100 ml	NS	NS	44	73	840	8	47	153

Table 12. Cont'd.

Station #12 Main Pool	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	19.7	12.2	28.0	30.0	28.0	18.0	NS	8.0
Water Temp. °C	20.1	11.0	26.5	27.5	24.0	18.5	NS	5.0
Water Depth Inches	20.0	15.0	18.0	18.0	6.0	10.0	NS	20.0
Secchi Disc Inches	10.0	8.0	6.0	6.0	4.0	2.0	NS	4.0
Dissolved Oxygen Parts Per Million	12.1	9.4	7.50	5.55	9.10	8.67	NS	13.24
Conductivity (Corr to 25°C) µohms	708	900	1400	1600	1500	910	NS	900
pH	9.3	8.2	9.22	7.80	7.65	8.71	NS	7.13
Total Coliform #/100 ml	NS	NS	12	40	220	20	NS	60

Station #13 Main Pool	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	20.0	13.3	31.0	29.0	29.0	18.0	NS	7.0
Water Temp. °C	20.1	10.2	29.0	27.0	24.5	18.5	NS	5.0
Water Depth Inches	17.0	12.0	12.0	13.0	12.0	5.0	NS	12.0
Secchi Disc Inches	10.0	12.0	3.0	3.0	0.0	5.0	NS	3.00
Dissolved Oxygen Parts Per Million	9.2	8.8	7.00	5.59	7.38	9.29	NS	13.71
Conductivity (Corr to 25°C) µohms	758	1111	1300	1800	1900	1000	NS	900
pH	8.9	8.1	9.15	7.85	7.43	8.62	NS	7.11
Total Coliform #/100 ml	NS	NS	76	33	640	27	NS	193

Table 12. Cont'd.

Station #15 Main Pool	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	23.8	13.5	24.0	NS	NS	17.0	6.0	4.0
Water Temp. °C	20.0	11.3	22.0	NS	NS	20.0	9.0	4.0
Water Depth Inches	12.0	5.0	6.0	NS	NS	36.0	36.0	36.0
Secchi Disc Inches	12.0	5.0	4.0	NS	NS	30.0	36.0	30.0
Dissolved Oxygen Parts Per Million	2.1	3.3	7.00	NS	NS	8.40	10.15	15.03
Conductivity (Corr to 25°C) µohms	806	1286	1200	NS	NS	920	920	920
pH	7.1	7.6	9.05	NS	NS	7.98	8.12	7.40
Total Coliform #/100 ml	NS	NS	>1000	NS	NS	193	733	94

Station #16 East Pool	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	25.8	19.2	35.0	26.0	26.0	18.0	9.0	5.0
Water Temp. °C	21.5	14.4	27.5	24.0	23.0	19.0	7.0	4.0
Water Depth Inches	14.0	16.0	13.0	13.0	12.0	13.0	11.0	10.0
Secchi Disc Inches	14.0	16.0	13.0	13.0	12.0	13.0	11.0	10.0
Dissolved Oxygen Parts Per Million	14.5	11.6	11.0	4.2	2.09	6.41	9.14	11.96
Conductivity (Corr to 25°C) µohms	949	925	1200	1200	1200	780	830	840
pH	8.5	8.4	9.25	5.80	7.89	7.33	7.77	7.60
Total Coliform #/100 ml	NS	NS	124	133	120	>2000	53	40

Table 12. Cont'd.

Station #19 N. Spring Pool	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	20.9	16.4	24.0	28.0	25.0	18.0	7.0	4.0
Water Temp. °C	20.5	13.1	24.0	31.0	27.0	18.0	11.0	4.0
Water Depth Inches	21.0	17.0	12.0	11.0	4.0	12.0	12.0	20.0
Secchi Disc Inches	21.0	13.0	12.0	2.0	4.0	*	12.0	20.0
Dissolved Oxygen Parts Per Million	6.0	5.1	2.0	9.51	5.66	1.15	7.70	10.07
Conductivity (Corr to 25°C) µohms	1674	1731	2400	3800	4900	1900	2000	1400
pH	7.3	8.0	8.95	6.80	7.59	7.20	7.50	7.08
Total Coliform #/100 ml	NS	NS	100	7	>2000	229	227	40

Station #20 S. Spring Pool	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	18.2	17.0	26.0	37.0	31.0	16.0	8.0	5.0
Water Temp. °C	23.0	14.5	32.0	33.0	24.0	22.5	12.0	4.0
Water Depth Inches	9.0	8.0	9.0	2.0	1.0	4.0	4.0	6.0
Secchi Disc Inches	9.0	8.0	3.0	2.0	1.0	4.0	4.0	6.0
Dissolved Oxygen Parts Per Million	10.0	9.5	11.0	6.70	9.12	10.36	11.27	10.87
Conductivity (Corr to 25°C) µohms	2101	1911	3400	3900	3050	2300	2100	1800
pH	8.3	8.0	9.00	7.75	*	7.84	7.90	7.10
Total Coliform #/100 ml	NS	NS	140	247	480	198	67	67

Table 12. Cont'd.

Station #17 Cayuga/Seneca Canal	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	24.1	19.0	29.0	28.0	27.0	21.0	8.0	4.0
Water Temp. °C	20.6	13.4	28.0	29.0	28.0	21.0	14.0	7.0
Water Depth Inches	34.0	72.0	48.0	44.0	48.0	26.0	24.0	18.0
Secchi Disc Inches	21.0	39.0	24.0	32.0	30.0	26.0	24.0	18.0
Dissolved Oxygen Parts Per Million	12.1	10.3	11.0	6.73	6.14	8.77	8.91	11.30
Conductivity (Corr to 25°C) µohms	952	946	920	1100	1200	830	880	920
pH	8.2	8.2	9.25	6.57	7.05	7.08	7.93	7.77
Total Coliform #/100 ml	NS	NS	76	167	467	60	60	100

Station #18 Cayuga/Seneca Canal	Sept. 1987	Oct. 1987	June 1988	July 1988	Aug. 1988	Sept. 1988	Oct. 1988	Nov. 1988
Air Temp. °C	21.0	13.8	30.0	28.5	23.0	22.0	8.0	4.0
Water Temp. °C	20.7	13.0	27.0	29.5	27.5	21.5	11.5	5.0
Water Depth Inches	47.0	55.0	48.0	56.0	60.0+	72.0+	72.0	60.0
Secchi Disc Inches	47.0	34.0	24.0	53.0	38.0	39.0	60.0	48.0
Dissolved Oxygen Parts Per Million	9.7	10.8	10.00	8.40	7.15	9.51	9.86	14.16
Conductivity (Corr to 25°C) µohms	542	884	810	810	680	63	460	390
pH	9.0	8.5	9.15	6.43	6.86	8.82	8.87	8.12
Total Coliform #/100 ml	NS	NS	276	7	187	86	47	20

Notes: NS = No Sample
* = See data sheet for explanation

Table 13. 1987 Montezuma National Wildlife Refuge Contaminant Study
Water Quality Monitoring Results

Station #	1		2		3		4	
Date	Sept. 1987	Oct. 1987	Sept. 1987	Oct. 1987	Sept. 1987	Oct. 1987	Sept. 1987	Oct. 1987
Air Temp. °C	17.0	13.8	22.2	13.2	23.5	13.2	22.5	14.8
Water Temp. °C	14.6	11.1	17.7	10.8	22.4	11.3	22.1	11.7
Water Depth Inches	8.7	12.9	6.7	8.7	13.0	15.8	32.7	37.0
Secchi Disc Inches	8.7	12.9	6.7	8.7	13.0	15.8	17.3	22.4
Dissolved Oxygen Parts Per Million	10.3	5.9	13.8	10.8	10.7	12.2	10.6	12.0
Conductivity (Corr to 25°C) uohms	1726	1549	1981	1470	1969	1479	865	903
pH	7.6	8.0	8.3	8.0	7.9	8.2	8.7	8.6
Carbonate Parts Per Million	530.8	2133.6	487.4	1138.0	520.0	228.2	187.2	1385.4
Chloride Parts Per Million	42.9	55.8	47.5	167.9	60.9	56.7	26.1	59.9
Sulfate Parts Per Million	540.8	495.4	701.1	513.3	708.6	481.0	195.5	202.6
Suspended Sediments Parts Per Million	13.3	20.0	33.3	3.3	40.0	3.3	59.3	13.3

Table 13. (Cont'd.)

Station #	5		6		7		8	
Date	Sept. 1987	Oct. 1987	Sept. 1987	Oct. 1987	Sept. 1987	Oct. 1987	Sept. 1987	Oct. 1987
Air Temp. °C	23.1	14.7	22.5	14.7	23.3	15.1	23.5	15.8
Water Temp. °C	21.1	11.3	22.2	11.8	22.8	12.0	23.5	12.8
Water Depth Inches	16.1	22.1	16.5	19.7	25.6	30.7	13.8	15.0
Secchi Disc Inches	12.6	16.1	14.6	19.7	11.0	21.3	10.6	15.0
Dissolved Oxygen Parts Per Million	9.2	12.3	7.8	8.9	12.4	12.0	13.2	12.2
Conductivity (Corr to 25°C) uohms	990	923	937	870	856	971	1020	1000
pH	8.2	8.5	8.1	7.7	9.3	8.6	9.3	8.6
Carbonate Parts Per Million	557.1	1156.3	1488.7	371.3	218.1	1072.0	498.0	1409.6
Chloride Parts Per Million	44.9	109.6	54.6	209.9	34.7	44.7	42.5	45.6
Sulfate Parts Per Million	275.5	247.9	195.3	210.1	177.0	248.9	245.2	249.5
Suspended Sediments Parts per Million	33.3	13.3	6.7	6.7	20.0	33.3	6.7	13.3

Table 13. (Cont'd.)

Station #	9		10		11		12	
Date	Sept. 1987	Oct. 1987	Sept. 1987	Oct. 1987	Sept. 1987	Oct. 1987	Sept. 1987	Oct. 1987
Air Temp. °C	26.1	11.6	22.3	11.3	21.8	11.6	19.7	12.2
Water Temp. °C	22.3	10.2	21.2	10.9	19.6	9.8	20.1	11.0
Water Depth Inches	11.0	6.7	25.6	22.4	16.9	12.6	19.7	15.0
Secchi Disc Inches	11.0	6.7	12.6	13.8	13.8	9.1	9.5	7.9
Dissolved Oxygen Parts Per Million	8.0	6.2	13.7	9.6	6.4	5.8	12.1	9.4
Conductivity (Corr to 25°C) uohms	845	836	888	799	669	751	708	900
pH	8.1	7.8	9.0	8.6	7.6	7.4	9.3	8.2
Carbonate Parts Per Million	197.5	<0.3	400.4	<0.3	640.9	<0.3	285.7	598.5
Chloride Parts Per Million	57.1	187.3	124.3	255.3	153.1	254.9	129.8	106.1
Sulfate Parts Per Million	104.4	83.8	38.4	59.5	67.2	66.6	41.7	93.3
Suspended Sediments Parts Per Million	113.3	13.3	46.7	40.0	20.0	66.7	53.3	60.0

Table 13. (Cont'd.)

Station #	13		14		15		16	
Date	Sept. 1987	Oct. 1987	Sept. 1987	Oct. 1987	Sept. 1987	Oct. 1987	Sept. 1987	Oct. 1987
Air Temp. °C	20.0	13.3	25.1	14.2	23.8	13.5	25.8	19.2
Water Temp. °C	20.1	10.2	22.9	10.3	20.0	11.3	21.5	14.4
Water Depth Inches	17.3	11.8	9.8	11.4	11.8	5.1	14.0	15.8
Secchi Disc Inches	9.5	11.8	9.8	7.1	11.8	5.1	14.0	15.8
Dissolved Oxygen Parts Per Million	9.2	8.8	13.2	10.4	2.1	3.3	14.5	11.6
Conductivity (Corr to 25°C) uohms	758	1111	896	927	806	1286	949	925
pH	8.9	8.1	9.2	8.2	7.1	7.6	8.5	8.4
Carbonate Parts Per Million	466.4	206.1	226.0	<0.3	704.4	259.0	138.8	350.3
Chloride Parts Per Million	158.3	227.6	52.0	187.9	179.6	140.1	75.2	209.8
Sulfate Parts Per Million	39.9	178.5	194.4	130.8	51.7	21.9	43.9	47.3
Suspended Sediments Parts Per Million	50.0	120.0	30.0	60.0	13.3	86.7	6.7	3.3

Table 13. (Cont'd.)

Station #	17		18		19		20	
Date	Sept. 1987	Oct. 1987	Sept. 1987	Oct. 1987	Sept. 1987	Oct. 1987	Sept. 1987	Oct. 1987
Air Temp. °C	24.1	19.0	21.0	13.8	20.9	16.4	18.2	17.0
Water Temp. °C	20.6	13.4	20.7	13.0	20.5	13.1	23.0	14.5
Water Depth Inches	33.9	72.4	46.5	55.1	20.5	17.3	8.7	8.3
Secchi Disc Inches	21.3	39.4	46.5	33.5	20.5	12.6	8.7	8.3
Dissolved Oxygen Parts Per Million	12.1	10.3	9.7	10.8	6.0	5.1	10.0	9.5
Conductivity (Corr to 25°C) uohms	952	946	542	884	1674	1731	2101	1911
pH	8.2	8.2	9.0	8.5	7.3	8.0	8.3	8.0
Carbonate Parts Per Million	190.7	326.9	810.9	300.8	157.4	1812.4	<0.3	1538.0
Chloride Parts Per Million	99.9	156.8	37.6	160.6	52.8	17.3	17.7	53.8
Sulfate Parts Per Million	51.9	49.0	426.5	53.8	42.4	800.6	1187.0	914.6
Suspended Sediments Parts Per Million	13.3	30.0	13.3	20.0	6.7	13.3	53.3	6.7

Literature Cited

American Public Health Association. 1971. Standard Methods. 13th Edition, Washington, D.C.

Connor, J.J., and H.T. Shacklette. 1975. Background Geochemistry of Some Rocks, Soils, Plants, and Vegetables in the Conterminous United States, USGPO, Washington, D.C.

Duorak, A.J. 1977. Toxicity of Trace Elements in Terrestrial and Aquatic Environments, Appendix to: The Environmental Effects of Using Coal for Generating Electricity. June. Argonne National Laboratory. Argonne, Illinois (NUREG-0252).

Eisler, R. 1985a. Cadmium Hazards to Fish, Wildlife, and Invertebrate: A Synoptic Review. U.S. Fish and Wildlife Service. Biological Report 85(1.2).

Eisler, R. 1985b. Mirex Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service. Biological Report 85(1.1).

Eisler, R. 1985c. Selenium Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service. Biological Report 85(1.5).

Eisler, R. 1986a. Chromium Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service. Biological Report 85(1.6).

Eisler, R. 1986b. Polychlorinated Biphenyl Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service. Biological Report 85(1.7).

Eisler, R. 1987. Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Fish and Wildlife Service. Biological Report 85(1.11).

Eisler, R. 1988. Arsenic Hazards to Fish, Wildlife, and Invertebrate. A Synoptic Review. U.S. Fish and Wildlife Service. Biological Report 85(1.2).

Jaques, H.E. 1947. How to Know the Insects. Second Edition. William C. Brown Company Publishers. Dubuque, Iowa.

Lemly, A.D., and G.J. Smith. 1987. Aquatic Cycling of Selenium: Implications for Fish and Wildlife. U.S. Fish and Wildlife Service, Fish Wildl. Leafl. 12.

Needham, J.G. and P.R. Needham. 1967. A Guide to the Study of Freshwater Biology. Fifth Edition. Holden-Day, Inc., San Francisco, California.

Obbard, M.E. and R.J. Brooks. 1980. Nesting Migrations of the Snapping Turtle (Chelydra serpentina). From Herpetological 36(2. The Hertologist's League, Incorporated.

Pennak, R.W. 1978. Freshwater Invertebrates of the United States. Second Edition. A Wiley-Interscience Publication. John Wiley & Sons. New York, New York.

Petokas, P.J. and M.A. Alexander. 1980. The Nesting of (Chelydra serpentina) in Northern New York. From Journal of Herpetology 14(9). Society for the Study of Amphibians and Reptiles.

Prescott, G.W., 1964. How to Know the Freshwater Algae. Pictured Key-Nature Series. Wm. C. Brown Company Publishers. Dubuque, Iowa.

Prescott, G.W., 1962. Algae to the Western Great Lakes Area. With an Illustrated Key to the Genera of Desmoids and Freshwater Diatoms. Revised Edition. Wm. C. Brown Company Publishers. Dubuque, Iowa.

Ruttner, F. 1963. Fundamentals of Limnology. University of Toronto Press.

Shacklette, H.T. and J.G. Boergnen, 1984. Element Concentration in Soils and Other Surficial Materials of the Conterminous United States. U.S. Geological Survey Professional Paper 1270, U.S. Government Printing Office, Washington, D.C.

Spehar, R.L., and R.W. Carlson, A.E. Lemke, D.I. Mount, A.H. Pickering, and V.M. Snarski. 1980. Effects of Pollution on Freshwater Fish. June. Environmental Research Laboratory. Duluth, Minnesota.

Stickney, R. 1989. Reviews in Aquatic Sciences. Volume 1/Issue 1. CRC Press. Boca Raton, Florida.

U.S. Environmental Protection Agency. 1976a. National Conference on Polychlorinated Biphenyls (November 19-21, 1975, Chicago, Illinois). March. Washington, D.C. (EPA-560/6-75-004).

U.S. Environmental Protection Agency. 1976b. Quality Criteria for Water. July. Washington, D.C.

U.S. Environmental Protection Agency. 1979. EPA's Preliminary Water Criteria for 12 Remaining Listed Toxic Pollutants. October (44 FR 56623).

U.S. Environmental Protection Agency. 1986. Quality Criteria for Water. 1986. EPA 440/5-86-001. May 1. U.S. Department of Commerce, Springfield, VA (PB87-226759).

U.S. Fish and Wildlife Service. 1986. Scope of Work for 1986 Montezuma National Wildlife Refuge Contaminants Study. New York Field Office, Division of Fish and Wildlife Enhancement.

U.S. Fish and Wildlife Service. 1987a. Results of 1987 Montezuma National Wildlife Refuge Sampling for Algae. New York Field Office, Division of Fish and Wildlife Enhancement.

U.S. Fish and Wildlife Service. 1987b. Scope of Work for 1987 Montezuma National Wildlife Refuge Contaminants Study. New York Field Office, Division of Fish and Wildlife Enhancement.

U.S. Fish and Wildlife Service. 1988. Scope of Work for 1988 Montezuma National Wildlife Refuge Contaminants Study. New York Field Office, Division of Fish and Wildlife Enhancement.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
100 Grange Place
Room 202
Cortland, NY 13045

January 12, 1990

Memorandum

TO: Refuge Manager, Montezuma National Wildlife Refuge

FROM: Acting Field Supervisor, New York Field Office

SUBJECT: 1988 Montezuma National Wildlife Refuge Contaminant Study Report

This report provides partial lists of both freshwater algae and benthic invertebrates found at the Montezuma National Wildlife Refuge and in Black Brook.

It further provides information on the following water quality parameters: pH, air temperature, water temperature, water depth, dissolved oxygen, conductivity, total coliform bacteria, water transparency, carbonates, chlorides, sulfates, and suspended solids.

Lastly, it provides the results of analyses for several potentially harmful contaminants in the common carp (Cyprinus carpio), brown bullhead (Ictalurus nebulosus), largemouth bass (Micropterus salmoides), and snapping turtle (Chelydra serpentina).

No major concerns were identified. It provides a baseline against which future changes can be compared.

John T. Hickey

Attachment

cc: w/o Appendices
USFWS, ARD, FWE, Newton Corner, MA
USFWS, ARD, RW, Newton Corner, MA